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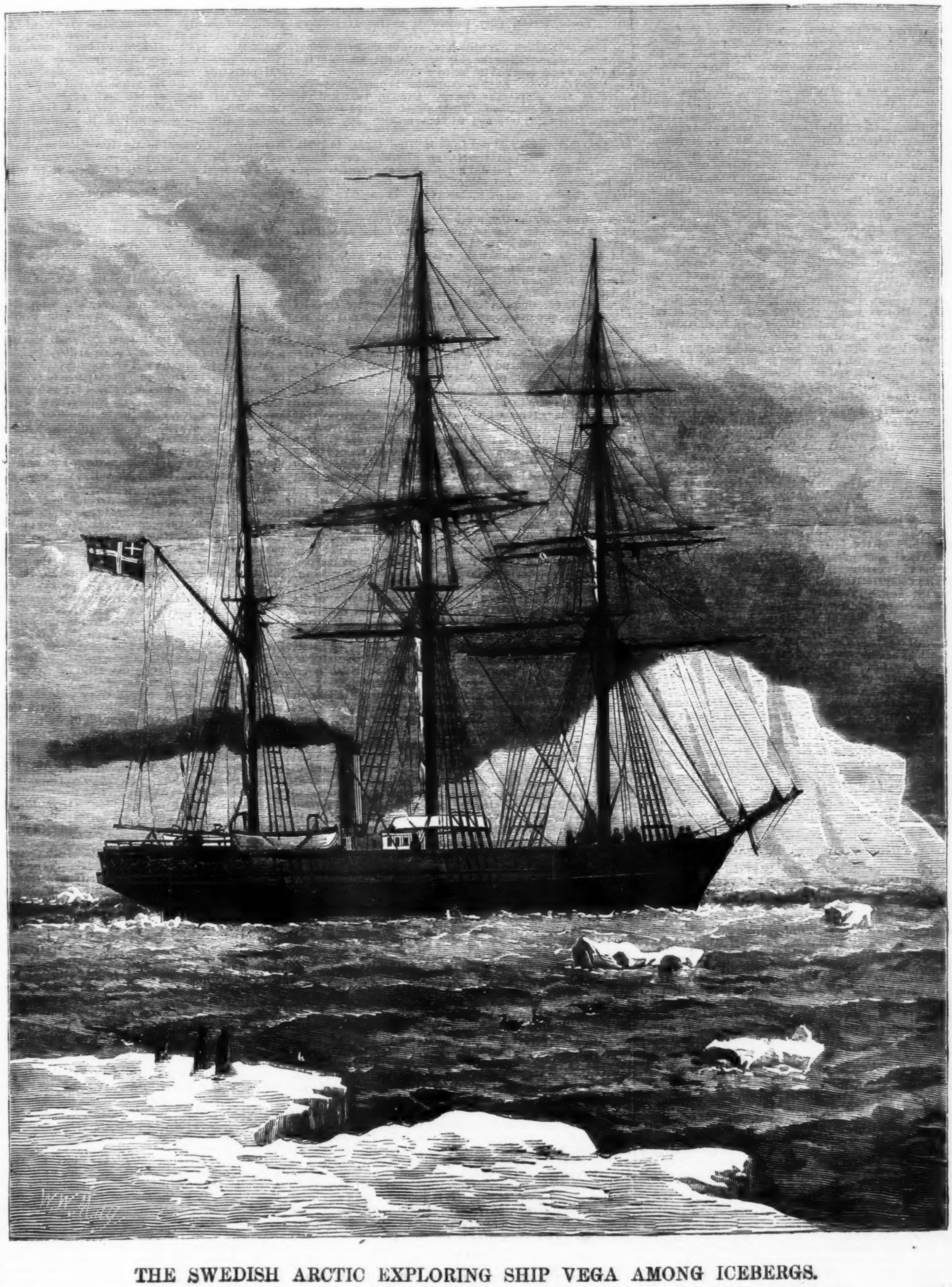


THE SWEDISH ARCTIC EXPLORING SHIP VEGA AMONG ICEBERGS.

THE SWEDISH ARCTIC EXPLORATION.

PROFESSOR NORDENSKJOLD'S recent grand achievement of navigating the Arctic Seas north of Asia, and passing eastward through Behring Strait down into the Pacific Ocean, has been crowned with a triumphal welcome at his arrival home. After receiving, since the entrance of his vessel through the Suez Canal into the Mediterranean, the congratulations of different governments and nations in Western Europe, he has reached the capital of Sweden, and has been duly honored by the King and the country. We have to announce that the Vega, a small steamer, built at Bremen, of three hundred tons' register, with an engine of sixty-horse power, which has circumnavigated the whole joint continent of Europe and Asia, having left Gothenburg on July 4, 1878, arrived at Stockholm April 24, 1880, at night. She was met outside by about two hundred steamers, which escorted her into the harbor. The adjacent coasts were lit up for a distance of many miles, and the city itself was splendidly illuminated. Professor Nordenskjöld and his companions were received on landing by the municipal authorities, and proceeded immediately afterwards to the royal castle, where they were welcomed by the King. Professor Nordenskjöld has been created a Baron, and Captain Palander and Mr. Oscar Dickson have received patents of nobility.

A thanksgiving service for the safe return of Professor Nordenskjöld and his companions was held on Sunday at the castle chapel. At its conclusion the King paid a visit to the Vega, and presented each member of the expedition with a medal specially struck in commemoration of the voyage. A banquet was given in the evening at the royal castle, at which all the members of the expedition,, including the crew of the Vega, were present. The King delivered a speech, in which he said that, notwithstanding the exploits of Diaz, Vasco da Gama, Christopher Columbus, Magellan, Cook, and other discoverers of new regions of the world beyond the seas, the northern coast of that part of the world, which was called the cradle of the human race, continued to be locked by a barrier of ice. The task of breaking this barrier was left, said his Majesty, to our time, and the great work has now been accomplished. The whole of the Swedish people joyfully welcomed the heroes who had fought, hoped, and finally conquered. Their greeting was given in the first place to Professor Nordenskjöld, the leader of the North-eastern Expedition, which had been so happily accomplished. Next to him stood Captain Palander, the intrepid commander of the Vega, while the dauntless explorers and sailors who shared their dangers now shared their glory. History would preserve the memory of this expedition. The beloved Fatherland gained fresh laurels to add to its past glories, and this conferred honor on those who had won them. The King concluded by saying: "In the name of the Swedish people and in my own, I assure you all of my gratitude and admiration."

The voyage, the main details of which were recounted a few months since, consisted of two stages; the first being the passage from the port of departure to that part of the Siberian coast in the neighborhood of the mouth of the river Lena. The vessel which accompanied the Vega to that point was also named the Lena, and was a smaller steamer, built of Bessemer steel. They passed Cape Chelyuskin, the most northerly point of the continent, on Aug. 19, 1878, and the mouth of the river Lena was reached on Sept. 7. The Vega alone went on to Koljutschin Bay. There, on Sept. 28, the Vega became fixed in the ice at a short distance from the mainland, and the further progress of the expedition was checked during the winter months. With the return of the brief Arctic summer, in July last year, the vessel was released, and Nordenskjöld, boldly pushing his way eastward through unknown waters, succeeded with comparative facility in skirting the coast, and rounding the northern capes of Kamtschatka, was enabled to direct his course southwards into the North Pacific Ocean, arriving on Sept. 2, 1879, at Yokohama, in Japan. The object of the expedition was thus accomplished, and the feasibility of making the North-east Passage conclusively demonstrated. The comparative ease with which Nordenskjöld was enabled to make the passage from the mouth of the Lena to the Pacific unquestionably indicates the possibility of opening a trade between Siberia and the rest of the world which was not before suspected; and it is far from improbable that means will be found of transporting from central Siberia, and thence by the seacoast eastwards, numerous products which are at present worthless from the want of means of bringing them to a market. Whether the newly discovered route can be thus utilized will remain to be seen, and will, of course, mainly depend upon whether the conditions under which the exploration has been made were exceptionally favorable, or may be reckoned on with confidence at certain seasons of the year.—*Illustrated London News.*

THE NORTH-EAST PASSAGE.

NARRATIVE OF CAPTAIN PALANDER, SWEDISH ROYAL NAVY, COMMANDER OF THE EXPLORING VESSEL.

YOKOHAMA, Sept. 12, 1879.

DURING a long succession of years numerous endeavors have been made to sail from Europe to the Pacific Ocean by the north of America or Asia—or, in other words, to discover the so-called North-west Passage by the north of America, or North-east Passage by the north of Asia. At first these attempts were made with the hope that by these routes sea communication might be obtained between Europe and the countries of the Pacific. That hope is now abandoned; and the voyages which during later times have been undertaken with the view of discovering the North-east or North-west Passages have been for exclusively scientific purposes.

The North-west Passage has been principally explored by Englishmen. The reason of this has been that Franklin, who, in 1845, left England with two vessels, the Erebus and Terror, to pursue that route, was never again heard of; and in consequence, numerous expeditions (for the most part organized by Franklin's widow, Lady Franklin) were sent out from England with the object of discovering the fate of the missing explorer and his companions. As all are aware, the present Admiral Sir F. L. McClintock, commander of the steam yacht Fox, brought home in 1859 indisputable proofs of his countrymen's sad end.

Undoubtedly no vessel has yet passed from the North Atlantic to the Pacific Ocean, or round the north coast of America; but, nevertheless, the discovery of this passage has been attributed to Sir R. McClure, captain in the English navy. In command of the ship Investigator, he took his course through Behring Strait, and followed the American coast until his progress was arrested by ice in long. W. 115°. After spending three winters there, he learned that some English vessels (belonging to Belcher's expedition, which from the east had endeavored to penetrate the North-west Passage) were lying some hundreds of miles from him. With all his crew, which had suffered considerably during the three successive winters, and had been subjected to more intense cold than any other Arctic expedition has outlived, McClure crossed over the ice to the ships formerly mentioned, and returned to England through Baffin Bay and over the Atlantic Ocean. In this manner he completed the North-west Passage, although two hundred miles of the way were accomplished by the use of sledges on the ice instead of by ship. On his return home he received promotion, and was voted by parliament a national reward of £10,000.

Since McClintock's return no expedition has been organized to penetrate the North-west Passage.

Circumnavigation of the north coast of Asia from the Atlantic to Behring Strait has been essayed by no less than thirteen expeditions. Of these, six were sent out by Holland, five from England, one from Austria, and one from Sweden; besides an unsuccessful endeavor to force a passage in an opposite direction, made by the famous Captain Cook, the English circumnavigator, in 1778.

In 1553, three ships were sent out by England; the Bona Esperanza, Captain Willoughby; the Bona Ventura, Captain Chancelor; and the Bona Confidentia, Captain Durforth. These vessels only proceeded as far as Novaya Zemlia.

In 1556, an English expedition went out under Stephen Burroughs, commanding the ship Searchthrift, which at the Kara Gate was compelled by ice to return.

In 1580 yet another English expedition is mentioned, consisting of two ships—the George, Captain Pet; and the William, Captain Jackman. These vessels entered the Kara Sea, and afterwards returned without making any further discoveries.

In 1594 there were sent out from Holland three, in 1595 seven, and in 1596 two vessels, all of which expeditions entered the Kara Sea, but did not proceed any farther east. All these voyages were shared by the famous William Barentz, the discoverer of Spitzbergen. The latest of these expeditions is remarkable on account of its being compelled to pass the winter on the north coast of Novaya Zemlia, which is the first occasion on record of a Polar expedition spending that season in the Arctic regions.

In 1608 an expedition went out from England, led by Hudson, but was unsuccessful.

In 1610, 1612, and 1625, expeditions were sent out from Holland under Hudson, Van Horn, and Boseman, which succeeded in entering the Kara Sea, where the ice arrested their farther progress, and they were compelled to return.

In 1676 England sent out her last expedition for the discovery of the North-east Passage. It consisted of two vessels, under the command of Wood and Hawes, and had no better success than its predecessors.

The want of success attendant on all the expeditions here mentioned appears to be attributable to the circumstance that they always returned too soon. The experiences of later times show that the Arctic Seas are most free from ice during autumn, immediately before it freezes anew. One cannot calculate with any certainty upon the Kara Sea being navigable before the first days of August, and it seems to remain so until the beginning of October, or perhaps even later.

After the English expedition of 1676 there occurs an interval of nearly two hundred years without any endeavor to make the North-east Passage. The country that now took up the great question was Austria, which, in 1872, sent out an expedition subsidized by private individuals. The ship bore the name of Admiral Tegetthoff, and was commanded by Lieut. Weytprecht, who was accompanied by Lieut. Payer, as leader of all land excursions. Of the vessel's being frozen in on the west coast of Novaya Zemlia, of its wonderful drifting with the ice, and consequent discovery of a new land, and of the crew's fortunate escape, it is not necessary here to speak, as a work has been recently published in which the whole is admirably described. The attempt made by this expedition to reach the North-east Passage proved unsuccessful, inasmuch as it gained no point farther than its predecessors with the same object.

A more fortunate issue has been reserved for the thirteenth expedition, organized to circumnavigate the north coast of Asia—the Swedish Arctic Expedition of 1878. Of its equipment and voyage I will now give some account.

When Professor A. E. Nordenskjöld, during the years 1875–76, crossed without difficulty the Kara Sea, which had hitherto been regarded as unnavigable, and penetrated to the mouth of the Yenisei River, which in the former year he sailed up, returning home overland by Siberia, it occurred to him that, with a good steamer, one could sail still farther east along the north coast of Siberia to Behring Strait. In the programme which Professor Nordenskjöld drew out for the promotion of an expedition with the object of sailing through the North-east Passage, he mentions as ground for the possibility of such a voyage, among other reasons, that the warm current which is formed by Siberia's many and powerful rivers, and the direction of which, by reason of the earth's revolution, ought to be from west to east, would be so strong, and would so heat up the water lying nearest the coast, that a navigable stream must be found there during the last summer months—namely, August and September. This opinion has now proved perfectly correct. Supported by the results of the successful voyages of 1875–76, and the opinion just mentioned, Professor Nordenskjöld succeeded in interesting His Majesty the King of Sweden, Mr. Oscar Dickson, merchant, and Mr. Alexander Sibirikoff, a Russian mine owner, in his project. They undertook to defray the expenses of the expedition. Afterward aid was obtained also from the Swedish Government, who liberally allowed £1,500 for the repairing of the ship to be used by the expedition, and permitted the work to be executed at the royal dockyards at Carlscrona. The government also made an allowance of 1s. 6d. per diem in addition to the regulation pay.*

The steamship Vega was bought for the expedition from a Swedish Sealing Company for the sum of £8,500. The Vega is a bark-rigged steamer, built in 1872 for seal and whale fishing in the Arctic seas, and consequently the exigencies of ice navigation have been duly considered in her construction. The vessel is five hundred tons burden, and its dimensions are: extreme length, 150 feet; breadth, 29 feet; depth of hold, 16 feet. It is provided with an engine of sixty horse-power, on Woolf's principle, which gives the vessel a speed of seven knots, with a coal-consumpt of 3 cwt. per hour. The Vega, which was not permitted to carry the royal flag, has sailed during the whole expedition under the flag of the Royal Swedish Yacht Club.

After having undergone considerable reparation of masts, sails, hull, and machinery at the royal dockyards, the Vega left Carlscrona on the 22d of June, 1878.

The ship's company was made up of the following officers, commissioned and non-commissioned, and men on leave of absence from the Royal Navy: Lieut. Palander, commander; Lieut. E. Brusewitz; F. A. Pettersson, engineer; R. Nilsson, sailing master; three firemen, of whom one acted as second engineer; four able seamen and four ordinary seamen; seven boatmen, one carpenter.

Besides the crew, the Vega was accompanied from Carlscrona by Lieutenants A. Hovgaard and G. Bove, belonging respectively to the Danish and Italian navies—the former the physiographer of the expedition, the latter its hydrographer. Both of these officers had been residing at Carlscrona to be present at the equipment of the ship. From Carlscrona we went to Copenhagen, from whence almost all the supplies estimated for thirty men for twenty-four months were taken in.

In provisioning the ship, special attention was paid to the regimen which must be followed during an Arctic voyage; consequently the supplies consisted chiefly of preserves. In the choice of provisions, care was taken to obtain everything of the best quality. Among other articles of supply taken to avert that pest of the Arctic regions, scurvy, may be mentioned lime juice, pickled cabbage, concentrated rum, pickles, preserved vegetables, mulberry jam, dried fruit, and preserved cream. After some days' stay at Copenhagen, necessary for the shipment and stowage of the supplies, we left there on the 26th of June, and arrived at Gothenburg on the following day. At Gothenburg the following gentlemen embarked: F. R. Kjellman, botanist, Fellow of Upsala University; Dr. A. Stuxberg, zoologist; O. Nordqvist, lieutenant in the Russian army, interpreter and zoologist; Dr. S. Almqvist, medical officer of the expedition; and a personal attendant for Professor Nordenskjöld. Provision and coal supply were completed here, and also we shipped the scientific equipment; sledges, and pemmican for sledge journeys; and two colly dogs, bought in Scotland.

On the afternoon of the 4th of July we left Gothenburg, not again to see the dear shores of our native land for nearly two years. A stiff contrary wind delayed our voyage to our next place of destination, Tromsoe, where we did not arrive until July 17. Here embarked the leader of the expedition, Professor Nordenskjöld, and three Norwegian fishermen.

Our number was now complete, and made thirty men all told, comprising nine officers and scientific gentlemen, three non-commissioned officers, and eighteen of a crew. In Tromsoe a full supply of water and coals was taken in, also a parcel of furs and sundry other articles.

At our departure from Tromsoe the coal supply consisted of nearly two hundred and twenty-five tons. At the lowest reckoning, with deduction of fuel for galley and stoves, it was estimated that the Vega could, solely with the assistance of her engine, make more than four thousand miles, which nearly corresponded to the distance between Tromsoe and Behring Strait.

From private sources the crew had been provided with under vests, drawers, stockings (long and short), and mitts of wool, sailcloth boots, fur mitts, fur caps, hoods, snow spectacles, etc.

On the 21st of July we steamed out of Tromsoe Harbor, accompanied by the steamer Lena, which was to go with us to the mouth of the river Lena, proceed up that river to Yakutsk, and thereafter be employed in the conveyance of passengers and goods.

The Lena was quite new, built to the order of Herr Sibirikoff, formerly mentioned, at the Motala Engineering Works, of Swedish Bessemer steel, provided with a high-pressure engine of 15 horse power, which consumed 2 cwt. of coal per hour. She was 90 feet long, 17 feet broad, and 7 feet draught, with a cargo of 65 tons dead weight, including coals. She cost £2,500, and, like the Vega, carried the Royal Swedish Yacht Club's flag. She was commanded by an experienced Norwegian whaler, and had a crew of nine men. She was supplied with provisions for sixteen months, and with forty tons of coal.

After having been compelled by a severe storm to take refuge for three days in a bay near North Cape, we ultimately got out to sea on the 25th of July. A pretty stiff breeze with heavy sea soon brought about our separation from our lesser companion the Lena, and we did not again see her until the 31st of July, the day after we anchored at our rendezvous, Yugorscharr, the sound lying between Waigatz Island (south of Novaya Zemlia) and the mainland. At Yugorscharr we also met other two vessels, the steamer Fraser and the bark Express, which, through Professor Nordenskjold, had been chartered for account of Herr Sibirikoff to load a cargo of grain and tallow at the mouth of the Yenisei.

At Yugorscharr there is a village of which the inhabitants are partly Samoiedes, partly Russian. The Samoiedes there settled were Christians, spoke pretty fair Russian, and had a church of their own, although it was little better or larger than a very small and poor wooden hovel. They are a people of small stature, with broad faces, prominent cheek bones, yellow complexion, oblique eyes, and flat noses. Their costume is much like that worn by the Lapps. They live on what they catch of seals and fish. The Russians in the village remain there only during summer, during which season they fish and barter goods with the Samoiedes, returing in the autumn to the interior of Russia. They usually have their homes in Petchora or that district.

On the 1st of August, with beautiful weather, all four vessels (the Express in tow of the Fraser) left their anchorage at Yugorscharr and were soon in the Kara Sea, which was then completely free from ice as far as the eye could reach.

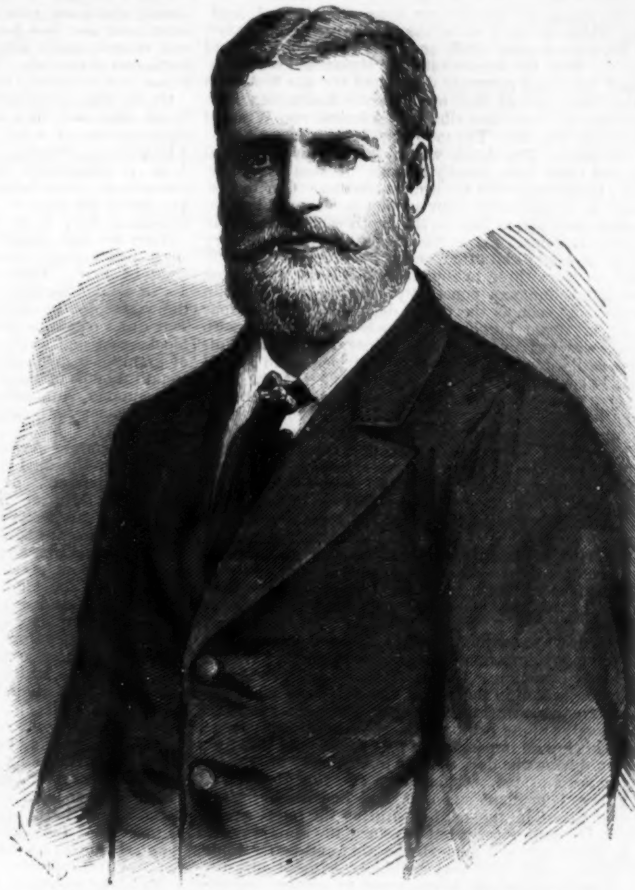
At our entrance into the Kara Sea the scientific work of the expedition began. From that day were instituted complete meteorological observations, dragging, sounding, investigations of the temperature, and of the specific gravity of the water at different depths.

Early on the morning of August 3 we met the first drift ice, which was, however, of such a description as could be easily passed through. With the object of avoiding contact with more compact and stronger ice we streered down toward the coast of the Samoiede peninsula, which we followed as close as the shallow water permitted. The land, which is properly only a sandbank cast up by the powerful river Obi, could not be seen by us, although the atmosphere was quite clear. We met here only spread and easily navigable drift ice.

The Lena, with Hovgaard, Almqvist, and Nordqvist on board, was sent off to investigate the sound lying between the peninsula and White Island, but found it im-

* Pay and rations were provided by government only for those of the expeditionary officers (commissioned and non-commissioned) and men who were in the naval service. The private contributions supplied an extra allowance of £3 10s. per month to each of the crew.

PROF. NORDENSKJOLD, CHIEF OF THE SWEDISH ARCTIC EXPEDITION.



CAPTAIN PALANDER, COMMANDER OF THE VEGA.

possible, on account of the numerous sandbanks, to go through it. As a result of very nasty weather, and the poverty of the land in animal and vegetable life, the harvest reaped by our scientific companions on this occasion was somewhat meager.

On the 4th of August we rounded the point of White Island in water entirely free from ice. Here we met a stiff breeze from the north, which, in conjunction with a high cross sea in three or four fathoms of water, was anything but agreeable, particularly as no trustworthy chart of these regions is yet to be had. The water was of a brown color, precisely similar to that of many of our own rivers in Sweden. Danger of stranding, however, does not exist, even although one should happen to be near the flat shores of the White Island during a storm, because the powerful current from the confluence of the Obi and Yenisei rivers in the neighborhood of the above island sets north during the summer season with a velocity of three to five knots.

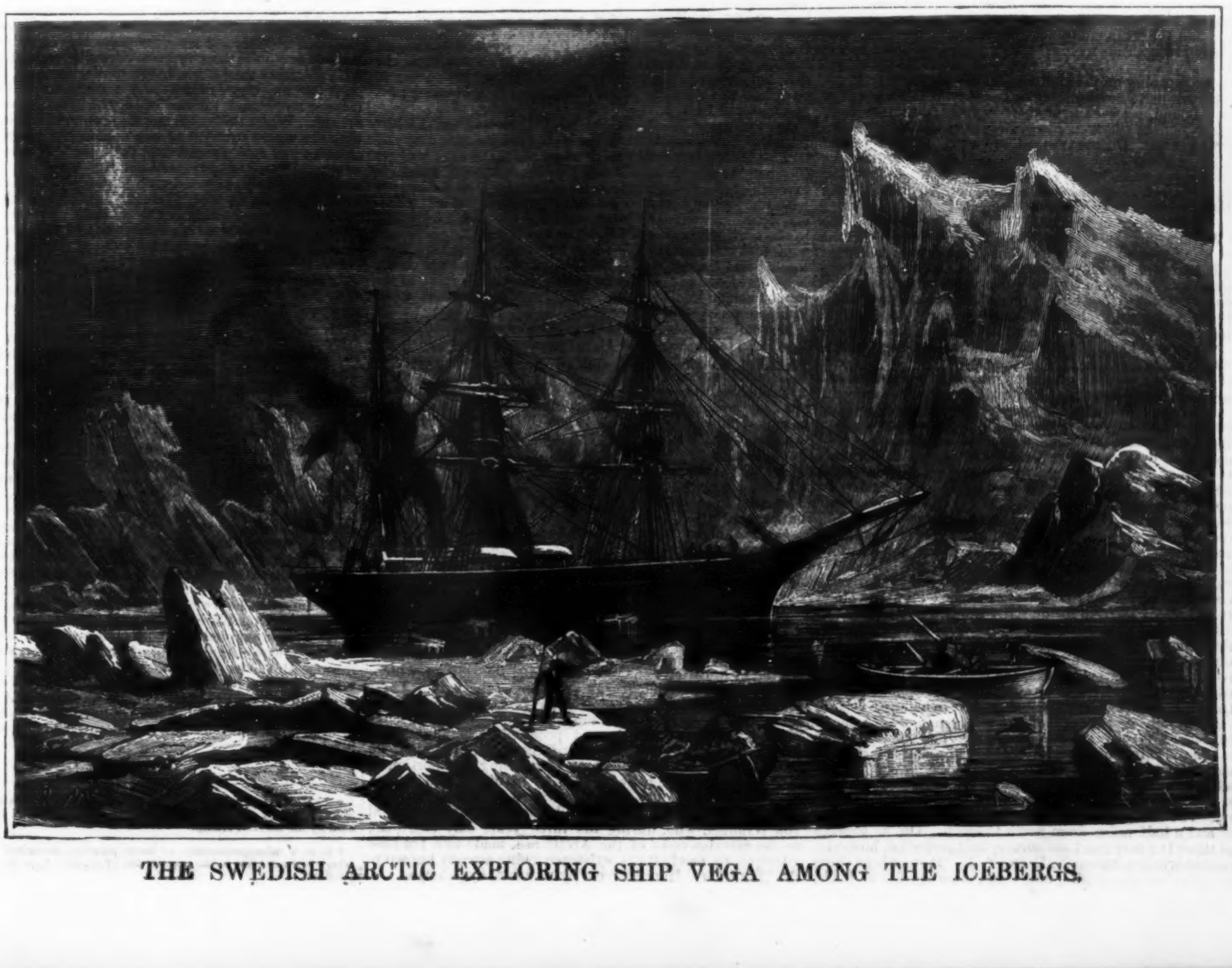
On the 6th of August we anchored beside one of the group of islands which lie outside Dickson's Harbor. Two hours later the Express and the Fraser anchored near us. In the afternoon, after the course had been examined by the steam launch, we went farther in and anchored in the harbor, which is well protected by land on all sides. The following day the Lena arrived from its exploring expedition.

Both in Yugorscharr and Dickson's Harbor the Lena as well as the Vega took coal supplies from the Express, which had carried about four hundred tons of coal from London instead of ballast. By these vessels letters and telegrams were dispatched to be further transmitted from Norway.

On the 9th of August the Express left us in tow of the Fraser, and steered up the Yenesei, to ship at the appointed place, Yakovieva, the cargo formerly mentioned.

After having mapped the harbor, prosecuted various scientific investigations, and made the ship clear for sea, we left our anchorage early on the morning of the 10th of August, and steered for the Arctic Sea. The course was set for the Kammeni Islands, with the intention of afterward following the coast of Taimyr Land to Taimyr Island. Already, during the first day, we met several small islands, which, according to the chart we had, should have lain sixty miles further east.

This was not the last time we made the discovery that the coast was described in this chart as much farther east than in reality it is. This was particularly noticeable when we reached the other side of Cape Tchelyuskin, where, accord-



THE SWEDISH ARCTIC EXPLORING SHIP VEGA AMONG THE ICEBERGS.

ing to the map, we sailed over long stretches of land. The map which we used as a chart had been constructed by the Russian general staff, and was founded upon old delineations from the seventeenth and eighteenth centuries. We found the coast correctly delineated for the first time from the other side of Kolyma River to Koliutchin Bay. That portion has been described by Admiral von Wrangel as recently as 1821–23. The map was, besides, more a land than a sea chart. The depth was indicated in very few instances, and these were usually at fault. It was necessary, therefore, to proceed with the utmost caution. Our regulations were to sound every hour as long as we were in deep water—that is to say, as long as the depth was not less than seven to ten fathoms. At a less depth we sounded every quarter of an hour; and often, when we were sailing along the coast, in from three to four fathoms of water, or even less, the hand line was constantly employed for days in succession. As soon as the depth decreased to about four fathoms, the steam launch, which was always kept with steam up, was put out and sent before the Vega. This could be easily done in water free from ice or in spread drift-ice; but when the ice was so compact that the Vega had to force a passage through, the steam launch, of course, could not be used.

Only upon one occasion, when we stood eastward from Cape Tchelyuskin, we sounded and found seventy fathoms; at no other place, even when far out at sea, had we more than twenty fathoms, and as soon as we neared the coast the depth gradually decreased to three or four fathoms and under. Usually, we sailed in a depth of from five to seven fathoms.

On the 11th of August we anchored near an unknown island to await better weather, there being a storm of wind and rain right in our teeth. On the afternoon of the same day, when the wind had somewhat moderated, we continued our voyage.

On the 12th we encountered drift-ice, but so spread that, without too many deviations, we contrived to go forward in a north-easterly direction. The ice now began to be accompanied by fog, which in the Arctic waters is more dense than anywhere else in the world. As long as there is drift-ice in the neighborhood, so long can one almost with certainty calculate upon having an impenetrable fog, which only lifts for a few hours during the day, usually immediately after noon or early in the morning. Often when the fog disperses at mid-day there is brilliant sunshine, and one discovers that the course taken in the drift-ice during the fog is wrong, and there is nothing for it but to return the same way and begin to push forward anew by another and better route. The fog rises and falls very suddenly without any premonitory signs, and might be compared to a stage curtain, which is alternately raised and dropped.

On the 13th of August, during a dense fog, we found ourselves close upon land right ahead of us, as well as on both sides. Fortunately we were proceeding with such caution that, by backing, we could come to a standstill before we had run ashore. We anchored, and, when the atmosphere cleared somewhat for a few moments, we found that the land beside which we had anchored was simply an isolated heap of stones of a C form lying out in the sea. For the remainder of the 13th and part of the 14th we lay in compact drift-ice and fog, unable to make any advance. On the evening of the 14th we were favored with a few hours' clear weather, and managed to make a little progress landward, where the ice appeared thinnest. As our scientific party wished to go ashore for the purpose of collecting, we anchored in a bay on the southwest of Taimyr Island. The bay was named Actinia Harbor, on account of the vast numbers of Actinia (or sea-anemones) which were found on the bottom. Here we were detained three and a half days by a dense fog. During that time, with the aid of the steam launch, there were several excursions made to investigate the sound lying between Taimyr Island and the mainland, which at its western mouth was so shallow, narrow, and rocky, that the Vega could not pass through it. The current here always runs westward with a speed of three to five knots.

On the morning of the 18th of August the fog rose so far as to permit us to go to sea. The course was taken north of Taimyr Island, between some reefs covered with bowlders, which were now and then discernible through the rapidly-returning fog. During the night, after having passed through a great deal of drift-ice, and seen at a distance several large islands lying northward, we sighted the land south of Cape Tchelyuskin. The land here lay considerably farther west than as delineated on the chart.

On the afternoon of the 19th of August we doubled the Old World's most northerly point, Cape Tchelyuskin, the Vega being the first vessel which has succeeded in so doing. At 6 P.M. we anchored in a creek on the eastern side of the above cape. The national flag was hoisted, a salute given, while on the shore stood a large polar bear to bid us welcome. That night and the following forenoon were employed in deciding the position of the cape (which was found to be lat. N. 77° 36′, long. E. 103° 25′), and in making various scientific investigations.

At 1 P.M. on the 20th of August we raised our anchor and steered in a north-easterly and easterly direction as far as the ice permitted. We now no longer followed the coast, our intention being to see if we might not possibly discover farther out some hitherto unknown islands or continents. But by the 22d we were so entangled in compact drift-ice that during the fog which prevailed we found the utmost difficulty in finding our way back to the coast. To penetrate farther east in this latitude was then impossible.

On the morning of the 24th we were again near land, and found there a channel from three to five miles broad, and almost quite free from ice. We sailed along the coast in this stream almost directly south, in a depth of eight to fifteen fathoms. Our map demonstrates how incorrectly the coast here has been delineated, and shows that we stood four and a half degrees inside the supposed coast line. In contrast with the other parts of the north coast of Siberia, which almost everywhere is low, with a gradual elevation landward, there is here a high mountain chain with remarkably beautiful snow-clad peaks, the height of which we estimated at 2,000 feet.

On the same afternoon we anchored at Khatanga Island, at the mouth of the bay of the same name. Khatanga Island had a very singular appearance. The northern side was about 250 feet high, and descended perpendicularly into the sea. From the northern summit the island sloped gradually away to the south, where its shores were finally lost in a sandbank which stretched far out into Khatanga Bay. The island was about one mile from east to west and one and a half miles from north to south. On its western side there is a very good anchorage, only protected, however, from the winds between N.E. and S. E. Its northern shore was quite covered with puffins and other species of birds, among which our guns made great destruction. Two polar bears were also shot here. At 9 P.M. we raised our anchor, and steered under alternate fog and clear weather for the north-east of the bay. The light nights were at an end, and it was now extremely dark about 10 P.M.

On the 25th of August, following the coast, we passed the North Bay, and then took our course eastward in four to eight fathoms of water. In the early morning of that day, which was a Sunday, there was a dense fog; but about 10 A.M. it completely dispersed, and the day became the warmest and most beautiful we had during our whole voyage along the coast of Siberia. The thermometer showed as high as +4·7° C. in the shade.

After we had passed the North Bay the want of depth compelled us to go so far out to sea that we could barely keep sight of land. There we met with many *torosser* aground. *Toross* is the Russian designation for walls formed during the winter by the constant forcing up of the ice. They sometimes reach the height of 100 feet, and consist of ice-blocks cast one upon another—the whole not unlike a heap of gigantic sugar-loaves lying topsy-turvy. These *torosser*, should they be of large dimensions, are not acted upon by the summer sun, but remain, and certainly constitute a good beacon for seamen to avoid the ground upon which they rest.

On the 26th of August we continued to follow the coast in an easterly direction in a depth of from six to eight fathoms, pursued by our old enemy the fog. In the evening, at dusk, we sighted a long narrow sandbank, which rose only a few feet above the level of the sea. We steered southward toward land with the intention of sailing round its southern extremity; but after following the edge of the bank for about six hours, and as it then appeared to run quite up to the land, we turned and stood out toward the north. This sandbank, which at high water or during darkness is exceedingly dangerous for the navigation, lies about twenty-five miles from the delta at the mouth of the Lena, and its southern extremity is probably connected with Olenek Land. It lies north and south, and is probably cast up by the river Olenek and the western arm of the Lena.

After having gone round the sandbank we proceeded on our voyage, steering eastward for the Lena's most northerly mouth. At this point a pilot from Yakutsk was to meet us to take the steamer Lena up the river to that town.

As the river Lena has numerous mouths in its northern delta, it had been prearranged that the pilot, who, during the whole of the navigable season, must be found at the place, should set a sea-mark at that mouth where the greatest depth was obtainable. Our intention was to accompany the Lena to the mouth of the river, and remain there for a few days for scientific research. But on the night of the 27th August, when we were outside our proposed anchorage, we found navigable water and a favorable wind. The opportunity was too good to be allowed to slip out of our hands. In the utmost haste we closed our letters and telegrams to our friends at home and sent them on board the Lena. She was now left to her own devices to prosecute her journey to her place of destination. We spread our canvas, and, making good speed, proceeded eastward to work out our way alone through the remaining portion of the North-east Passage. Our lesser companion had proved most useful to us, as whenever the water became shallow she preceded us and took soundings.

On the 28th August we were again among close but nevertheless navigable drift-ice. At mid-day we sighted Wasilieffski Island on our starboard-bow, which we ought to have had on our other side far to the north. We had then not taken observations since the 26th.

During that interval of forty-eight hours the current from the rivers Lena and Yana carried us seventy miles to the north. We went on the south side of Wasilieffski Island, from which there stretched out in a southerly direction a sandbank so low that it was only at a distance of eight miles from the island that we managed to pass it in a depth of eighteen feet. This proves the validity of the general rule that all islands north of Siberia are extremely flat on the southern side, but contrariwise, precipitous and deep on the northern, on which side they can usually be passed at a distance of a few hundred feet.

As Professor Nordenskjold wished to land on Liakov Island, the most southerly of the New Siberian group, to collect mammoth and other fossil remains, the course was set for that island's western shore. On the 29th we had such exceedingly hard work among close drift-ice that it was only with the utmost difficulty we could go forward at all. Ultimately we succeeded in forcing our way through, and passed to the north of Stolbovoi Island, on the eastern side of which we found completely clear water for about ten miles. Here the log was heaved, and it was found that the Vega, using her sails alone, and with a favorable wind, was going at the rate of eleven knots an hour. This was the greatest speed attained during our voyage along the Siberian coast.

The following morning we stood in toward Liakov Island, to which, in consequence of the shallows, we could make no nearer approach than at four to five miles distance; and these shallows, in conjunction with an impending fog, made it impossible to go ashore. We therefore steered southward for Cape Sviatoi, the point of which we doubled, after much trouble with the ice, in the night between 30th and 31st August. From thence we had two days of exceedingly good weather, during which we sailed along by the coast in water all but quite free from ice. We required, however, to keep some little distance out, as the water was shallow. The coast here was very flat, and was almost invisible to us on account of fog.

On the night between the 2d and 3d of September the drift-ice closed up; the temperature, which had hitherto in general kept above zero, now fell below, and we had our first real snowfall. On the 3d of September, during the day, in a snow-storm, we rounded the point lying north-east of the mouth of Kolyma River. The coast here was somewhat high and mountainous. We sailed at some cables'-length distance from the coast, and, with alternate snow-storms and clear weather, passed between the Bear Islands. On the most easterly of these there stand four pillars, which, like so many beacons, spring erect above the land. These pillars, which are composed of some plutonic mineral, are, according to Baron von Wrangel, forty feet high. After passing the Bear Islands, and proceeding in an easterly direction among very compact drift-ice, during the night we steered north-east, with the hope of reaching that portion of land as yet untrodden by the foot of civilized man known as Wrangel Land, also sometimes called Kellet Land. The Americans and Russians have called this land after Admiral von Wrangel, who, during his three years' stay (1821–23), on the Siberian coast of the Arctic Sea, made two fruitless attempts to reach it (its existence being already known to the Tchuktchis) from Kolyma by means of dog-sledges.

The natives at Cape Yakan and North Cape* had repeatedly in very clear weather, most probably under peculiar atmospheric conditions, seen land in the north-east; this suggested to Admiral von Wrangel (who was sent out by the Russian Government to survey the Siberian coast) an endeavor to reach that land. Wrangel was met either by an impassable barrier of ice (high *torosser*) or by ice-fields here and there rent asunder, with large fissures between the latter, called by the Russians *polynjor*.† The result was that he had to return without arriving at or even seeing the land in question. As the natives relate that for some time past they have seen during the winter people unknown to them coming over the ice from the north-east, and returning the same way, it is inferred that Wrangel Land is inhabited.

The English have called the land after their countryman, Kellet, commander of the English man-of-war Herald, with which, in 1849, he endeavored to penetrate thither. Kellet's attempt with that object succeeded no better than Wrangel's. He arrived at an island, which received the name of Herald Island, from whence, under the atmospheric conditions formerly alluded to, he believed he saw Wrangel Land.

The American whaling-captain Long (of the bark Nile, 1867) is the last who saw and also took good bearings of the south coast of Wrangel Land, which he passed at a distance of twelve miles.

On the morning of the 4th of September, after having done our best during the night to force a passage through, we found our way toward the north-east completely barred by strong, compact drift-ice, united by newly-frozen ice two inches thick. There was nothing else to be done but to endeavor to make the land, which, during the night and after most fatiguing labor, we succeeded in reaching direct west of Cape Baranoff. Here we found a fairly broad channel, seven to eight fathoms deep, and free from ice. In future we made no further attempts to stand out northward, where we invariably met with impenetrable ice, but kept the whole time as near the coast as the depth permitted. This is really the surest way of making progress, as on the coast there is the efflux of larger or smaller rivers, which either cause it to be free from ice, or keep the broken ice-fields in constant motion so long as they are not united by fresh ice.

On the 5th of September we kept along the coast in a navigable stream. In the afternoon we passed under steam and full sail, with a favorable wind, Tchaun Bay. This was the last time in 1878 that we had an opportunity to carry sail. After this the ice became so close, and our course was so intricate, that we could not use canvas. The night of the 6th September was the first night that the darkness prevented us from advancing. In future, during the darkest part of the twenty-four hours we had always to moor either to an ice-field, or, still better, to a portion of ground ice.

On the 6th of September, during the day, we sighted the high land of Cape Shelagskoi, which we reached after some hours' struggle with a belt of drift-ice. Immediately to the east of this point we had our first sight of the natives, who came rowing toward us in two boats made of seal-hide. They could, however, afford us no information in regard to the coast or the condition of the ice, as they could speak no language but their own, Tchuktchis. After this we daily passed one or more native villages and received visits from this kindly people.

At Cape Shelagskoi the difficulties of the expedition seemed only to begin. From thence we encountered solid, compact ice, and could barely go forward two ships' lengths without collision with the same. On the 7th September we passed Cape Yakan, and on the 8th, 9th, 10th, and 11th worked our way through close, strong drift-ice, which was sometimes so impenetrable that we were compelled to moor to it and await some change in its position. Only such a mode of procedure made it possible for us to get on. Occasionally we might make one or two miles, but usually only a few lengths of the ship. With the steam constantly up, we were prepared to take advantage of the smallest opportunity afforded by the ice of going forward. Fogs, shallows, and ground ice were now the order of the day. For whole days in three fathoms of water, sometimes, indeed, with not more than a few inches under our keel, we had to push our way through drift and ground ice. These latter masses, larger and heavier than the Vega, had to be removed. When this could not be accomplished by pressure with the whole strength of our machinery, we had to make an onset and rush against it at full speed. Only a vessel so strong and well constructed as the Vega could for any length of time have stood such blows. To run at full speed against ground ice is equivalent to rushing against a fixed object. Either the ship or the ice must give way. Nevertheless our Vega went victorious out of the combat, not a single scratch appearing on her sides of scarlet oak.

She frequently stuck fast between two ground ices, the only possibility of getting free being to blast with powder, or to hew away, by means of ice tools, so much of their tops as lightened them sufficiently to allow them to float.

On the 12th of September, in the forenoon, we arrived at the North Cape, where we were detained six days by ice. The North Cape consists of two promontories, some hundred feet high, jutting out from the mainland. They inclose a shallow bay, about half a mile in length, with an inlet between north-east and north-west. In this bay the Vega lay shut up by the drift-ice. On the low sandbank which unites these promontories was situated a Tchuktchi village. We found the chief, Tcheporin, a particularly attractive man. It was very amusing to see his astonishment when, on one occasion, we invited him and his wife, Atanga, to the saloon, where he saw a number of things which to him appeared most wonderful. He was presented, among other articles, with an old gold braiding, which he bound round his wife's head like a diadem, placing the loop in the center of her brow. Great was his delight at the performance on the barrel organ. First he commenced to quiver in every limb, and soon he was dancing most vigorously. For hours he would contemplate his brown yellow face in a mirror.

We here attempted to take a course of tidal observations, which, however, on account of our apparatus, and their collision with the ice, were unsatisfactory. The greatest deviation was only from five to seven inches. At last, at mid day, on the 18th of September, the ice dispersed so far as to permit us, creeping along the sandy coast, in three fathoms of water, to continue our course toward our goal, Behring Strait.

(*To be continued.*)

* By North Cape is meant here and hereafter that promontory lying in lat. N. 69° 50′ and long. E. 180°, which properly should bear the name used by the natives, Irkaipi.

† It is a misapprehension of these *polynjor*, described by Wrangel, which first gave rise to the popular but groundless hypothesis of an open polar sea.

THE SUEZ CANAL.

A CORRESPONDENT of the London *Times* says: It is just seven years since I last passed through the Suez Canal, and it is about the same time since I saw Port Said. Many changes were promised seven years ago, and I expected much on my return. But nothing has really been done, and I feel as if it were yesterday that I went through the Egyptian Bosphorus in the good ship Nubia. The vegetation along the banks is just as scanty, the trees that were promised have never been planted, the same wild waste of desert with its marvelous mirage of lake and woodland still meets the eye, the deep-water passage of the ship canal remains only twenty-four yards broad, and the fifteen *gares* or widened spaces where ships can pass each other have not been increased in number. The broad but useless Bitter Lakes, the wide reaches of Timseh, Bala, and Menzaleh, are still only used as waterways for the passing ships. Indeed, the only improvement I observed after my seven years' absence was that the banks of the canal had been faced with stone for about a quarter of its whole length. Not a single town, not even the smallest hamlet, has sprung up on its banks. Ismailia, which was to be the capital of the Isthmus, is hardly more than a deserted village, the scanty inhabitants of which wander disconsolately through its silent streets. The great fresh water canal which debouches there from Cairo brings no traffic of importance, and the restoration of the ancient land of Goshen, through which it passes with its fertilizing stream, remains a thing of the future. No wonder the passengers pronounce the canal a dull affair as they steam slowly through the vast solitude at the regulation five knots an hour.

Port Said has not advanced any more than the rest of the Isthmus. The railway which was promised from the Delta has never been undertaken; the canal which was to join it with Damietta is forgotten; the vast salt marsh which cuts off the town from all cultivation still stagnates over four hundred and fifty thousand acres, the favorite haunt of pelicans and flamingoes; and Port Said seems doomed to the meager glories of a big coaling station on the highway of nations, but outside all civilization. Seven thousand Arabs thrive on the transfer of coal from wharf to ship, which they do in huge gangs at a rate that makes Port Said the fastest coaling place in the world. All the change I noted in the little red-roofed town lay in the great Dutch hotel built by the late Prince of Orange, and the much increased length of the westward breakwater. This bulwark against the sea has hard work to divert the mud-laden current which sets eastward from the Damietta mouth of the Nile. Constant dredging of the channel by a huge sea-going dredger of one thousand horse power hardly suffices to keep it clear, and the time must come when a supplementary jetty will have to be constructed some twenty miles up the coast to divert this never-ceasing supply of choking silt. A better plan would be to utilize for the benefit of the country the whole of the riches of the Nile, but I fear the day is far distant when this stock of fertilizing mud will cease to run to waste.

It is singular how the only danger that was despised at the creation of the canal is proved to be the one real impediment to its utility. The dreaded current from the Red Sea has turned out no danger at all, and the curves in the channel which were made to resist the effect of this current are now pronounced wholly unnecessary. Indeed, yesterday, when I came through in the Poonah, the longest ship that had ever entered the canal, these curves proved very serious obstacles to a quick passage. The sand storms and wash from the banks, which were other prophesied dangers, are readily controlled by the occasional use of the three small dredgers the company keeps ready for this work of clearance. To the confusion of the prophets, the canal easily maintains its normal depth, and only last week a large Russian ironclad, the Minime, passed through without any check, though she drew twenty-four and a half feet of water. But stoppages occur rather too frequently, as all ships that pass depend on the good steering of the meanest craft that precede them from station to station. If one ship goes on the bank an inevitable jam ensues and the whole commerce of Europe for the time is stopped. Now that the company is, at any rate for the present, commercially successful, they ought to seriously consider the advisability of increasing the number of stopping places, or even of widening the deep water channel, so that ships can pass each other everywhere. This latter task would not be so difficult, as the surface of the canal is nowhere under sixty yards broad.

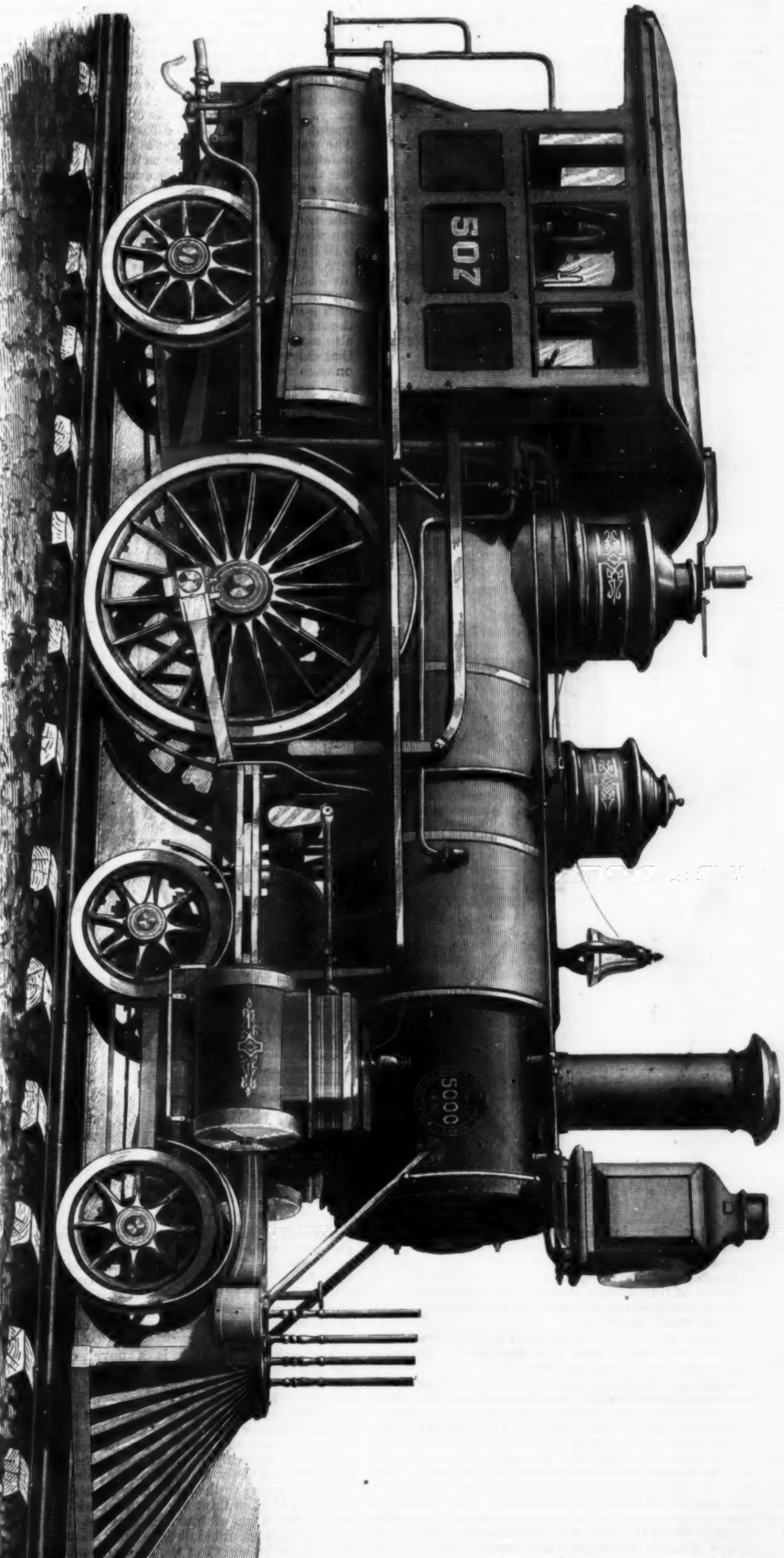
I found that quite four-fifths of the traffic of the canal is furnished by British commerce. It is not an exaggeration to say that if the British flag were withdrawn the canal would not last a decade. One English company alone pays on an average £160,000 a year to the concern. Yet the company is French, the officials are French, the pilots are French, the rules and regulations are French, and the whole of the Isthmus is nothing but a little France. However, the management on the whole is good, and the block system to avoid collision is maintained from station to station with all the method of a well-managed railway company. But the canal authorities should never forget their strictly international character, and favors as to a speedy passage should not be given even to a French mail line that are not equally shown to the mail steamers of other nations. The question might also be reasonably considered whether the concern is not overweighted with officials and officers. An establishment at Suez, another at Ismailia, a third at Cairo, a fourth at Port Said, a fifth at Marseilles, and a sixth at Paris are hardly consistent with the strict economy of a paying commercial business.

One cannot help feeling somewhat sadly how little good this great canal has done to Egypt. All the transit traffic from Europe southward used to pass through the valley of the Nile, while it is now all carried past us through this new arm of the sea. M. de Lesseps spoke unconsciously with a cruel irony when he persuaded Said Pasha to grant the concession to a universal company because "Egypt will then hold the key of the world, and the equilibrium of the Powers will be in her hands." It would have been more true if he had told the Pasha that Egypt would not only lose her proper trade, but also become a bone of contention among the nations. The Caliph Omar was a wiser man when he refused to join the two seas because the work would only benefit the barbarian. It would have been better for Egypt if Said Pasha had clung to the original idea, the idea that contented the Pharaohs, the Ptolemies, Amrou, Napoleon, and Mehemet Ali, and had been satisfied with the union of the Nile to the Red Sea. This, I may add, was the plan supported by the *Mail*, in the famous preliminary discussions, on the ground that as the silt of the Nile had already produced the Delta, choked Pelusium and the eastern mouth of the Nile, so it would choke the entrance of the proposed canal. Great expense will be necessary to prevent too literal a fulfillment of this prophecy, expense such as a commercial company can hardly be expected to undertake. But the time is, perhaps, not far off when the management of the Suez Canal must change its character, and its neutralization under international control will probably be its next phase of existence.

FAST PASSENGER LOCOMOTIVE.

THE locomotive, with a single pair of driving-wheels 6 ft. 6 in. in diameter, which has recently been finished at the Baldwin Locomotive Works, has attracted so much attention that we give this week an engraving of it, and also a view showing the back end.

On the Pennsylvania and some other lines a great deal of trouble has been experienced in the fast passenger engines from the breaking of crank-pins and coupling or parallel rods. On receiving the order for a locomotive to make the run between New York and Philadelphia, over the Bound Brook line, in two hours, the proprietors of the Baldwin Locomotive Works determined to use but one pair of driving-wheels, and thus dispense entirely with coupling-rods. With this arrangement the weight which can be utilized for adhesion must either be very considerably less than it would be if two pairs of wheels were coupled, or else there will be an excessive load on the single pair of driving-wheels. To provide for this difficulty the engine illustrated is arranged with equalizing levers, shown in the engraving, between the driving and trailing wheels. Each lever has a fulcrum, which works in a slot, and is partly shown just on the edge or periphery of the driving-wheel. Between this fulcrum and the driving-wheel a cam (not shown in the engraving) is arranged, which can be thrown down by a steam cylinder and piston, so as to form a bearing for the equalizing lever, and thus take the weight off from the fulcrum which is



FAST PASSENGER LOCOMOTIVE FOR THE BOUND BROOK LINE OF THE PHILADELPHIA AND READING RAILROAD, BETWEEN NEW YORK AND PHILADELPHIA. BUILT BY THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, PA.

shown. The cam then becomes the fulcrum of the lever, and one arm of the latter is thus lengthened and the other shortened, and consequently a larger proportion of the weight of the engine then rests on the driving-wheels. It is intended that this arrangement shall be used only in starting, or on heavy grades.

The dimensions of the engine are as follows:

Cylinders, 18 x 24 in.

Total wheel-base, 21 ft. 1 in.

From center of driving to center of trailing wheels, 8 ft.

Boiler, made of steel $\frac{7}{16}$ in. thick.

Diameter of boiler at smoke-box end, 52 in.

198 tubes, 2 in. diameter x 12 ft. 2¾ in. long.

Fire-box, 96½ in. long x 84 in. wide, 51 in. deep in front, and 44 in. back.

Grates, made of water tubes, 1⅞ in. outside diameter x ¼ in. thick, spaced 2⅞ in. from center to center, with three bars arranged to pull out.

Truck has a swing bolster and four 36-in. wheels, with cast-iron centers and steel tires.

Journals of truck axles, 5 x 8 in.

Steam-ports, 1⅝ x 16 in.

Exhaust-ports, 3 x 16 in.

The valve is of the Allen pattern, with ⅞ in. lap.

Cross-heads are made of solid wrought-iron, with brass gibs on slides.

Driving-wheels, 6 ft. 6 in. diameter, with cast-iron centers, having solid spokes and hollow rim.

Tires, 3 in. thick.

Driving-axles, made of wrought-iron, with journals 8 x 9½ in.

Trailing wheels, 45 in. diameter, with cast-iron center and steel tires.

Journals of trailing axle, 7½ x 8½ in.

Boiler supplied with two injectors. No pumps are used.

Tender carries 4,000 gallons of water.

Tender-frame made of channel iron.

NEW FAST PASSENGER LOCOMOTIVE.

Tender wheels 36 in. in diameter, with cast-iron centers and steel tires.

Tender axle journals, 5 x 8 in.

The weight of engine in working order is 85,000 lb.

Weight on driving-wheels, from 35,000 to 45,000 lb.

Weight on trailing-wheels from 15,000 to 25,000 lb.

Weight on truck, 25,000 lb.

The form of the fire-box is shown in the end view. The top and sides are stayed with ⅞ in. stay-bolts. The boiler has 1,400 square feet of heating surface.

The engraving also shows the extended smoke-box, which is 50 in. long, measured from the front of the tube-sheet. The arrangement of the inside of the smoke-box is somewhat different from the usual practice. In front of the tubes a sheet-iron deflector is placed, which is inclined from the top row of tubes downward and forward, with an opening below its lower edge and the bottom of the smoke-box. This opening can be increased or diminished by means of a movable section attached to the deflector. The smoke-box is divided into two parts by wire netting, having 3½ meshes to the inch, which is fastened to the tube-sheet just above the top row of tubes, and extends horizontally forward to the front and to both sides of the smoke-box.

The exhaust-pipes are carried up through this netting, and have a single nozzle 4½ in. in diameter just above it. The smoke-box can be cleaned from a hand-hole shown in the engraving on the under side of the extended smoke-box.

As considerable curiosity has been manifested regarding the working of this engine, it may be said that thus far it has been running only in an experimental way, and, as happens in all new engines, some little time is required before all the bearings work quite satisfactorily, and the boiler is thoroughly freed from grease, and the exhaust apparatus is adjusted in the most efficient way. On one trip, though, it ran, with a train of five empty passenger cars and a baggage car, from Trenton Junction to Bound Brook, a distance of 27·1 miles, in 26¾ minutes. In this distance there is a straight line of 13·8 miles, which was made in 11 minutes, which is at the rate of a little over 75 miles per hour. At the time, though, the engine was not steaming well, and, no doubt, it will be able to make even faster time than this.—*Railroad Gazette.*

A KANSAS MILL.

The mill and elevator built in 1879, at Manhattan, Kansas, by the E. B. Purcell Elevator Improvement Loan and Trust Company, is the largest elevator in the State, with the exception, perhaps, of one in Atchison, and is undoubtedly one of the most complete and convenient of any in the country, combining all the latest improvements and inventions. The flouring mill, which is the pride of Manhattan, and without doubt one of the finest and most complete mills in all its parts of any in the West, is built on the Kansas Pacific Railroad, adjoining the large elevator built by this company. The mill house is 32x46 feet, four stories high with basement, and the stories all being high, is of great value. The walls are very substantially built of stone and nicely pointed. The building is well proportioned in size, also are the doors and windows, and, with its mansard roof, makes a magnificent looking structure, and its broad foundation and solid walls make it a substantial one. In the basement will be seen a heavy line of shafting, extending the whole length of the mill house and through the south wall into the basement of the wareroom. On one end is a large pulley, which is driven by a long thirty-inch wide, five-ply rubber belt from the large band wheel of engine. On this line shaft running through the basement are seven 45x11 inch pulleys for driving the millstones, one pulley to drive the rolls, one the chop conveyor, and one the exhaust fan; also a pair of mortise bevel gears, to drive the upright shaft that extends to the top of the mill, from which the machinery on each floor is driven. The husk frames, on which the burrs rest, are all cast iron, of the best and latest improved patterns, and are securely bolted down to brick piers laid up with cement. There is an adjustable tightening pulley, in iron frame, for each run of burrs, conveniently arranged with hand wheels, so that each belt can be tightened or slackened with ease, enabling one man to start or stop either of the seven run without stopping or changing speed of the engine.

The exhaust fan here is a novel device for drawing the dampness or steam from the fresh ground chop and from the burrs, thus keeping the spouts dry and free from sour dough. There is a large collecting bin, in connection with this device, in which all the flour dust settles and is saved. Quite a number of elevators, used for elevating the grain, chop, etc., extend down to the basement floor. The first story is an elegantly finished room, the walls being nicely plastered and the woodwork tastily painted, while the woodwork belonging to the machinery is neatly put together of pine and black walnut oiled and varnished. On this floor are the seven run of four foot best old stock French burrs, substantially mounted on iron husk frames, which stand in line the entire length of the house on one side of room—one to grind corn, one middlings, and five wheat—and with the polished brass hoppers and nickel plate work, the entire line presents a grand appearance. There is also on this floor a set of large rolls. The second floor contains one of Keiser's improved bolting chests, one Becker brush machine, and all the bins or stock hoppers, which contain the cleansed grain and purified middlings ready to be ground. This bolting chest contains four reels, twenty feet long, and nine conveyors. The reels are well braced with truss rods, making them superior to those of other mills, and are clothed with the best silk bolting cloth of the Du Four & Co. brand. The third floor is for the "purifier," and one-half of the room is occupied by four large "American Middlings Purifiers."

There is also on this floor another four-reel bolting chest, made after same style as the one upon the second floor, a "Eureka" smut machine and an "Excelsior" bran duster. In the fourth story are the heads of all the elevators, ten in number, on one line shaft, one single reel bolting chest, one three reel chest, one Barnard wheat separator, and one corn meal bolt. The single reel is clothed with coarse bolting cloth, for the purpose of separating the bran from the flour before entering the superfine reels, making the work and wear on these expensive cloths much less than in the old manner of bolting. The three-reel chest is used for separating and dusting the middlings—preparing them for the purifiers, and for bolting the crushed middlings that come from the rolls on first floor. The machinery, from the engine to the last extremity of shafting, from largest to smallest machine, is the best that could be procured for money. And the planning and arranging of the machinery in the entire mill house could not well be improved, for, though the house may seem small for the necessary machinery for a seven run mill, it is not hampered or crowded, there being plenty of room for any man to pass through to examine all machinery with a suit of fine broadcloth and tall silk hat, and come out without the usual mill marks on his clothes. The bolting chests are all free and convenient to get at, not a spout, post, or elevator in the way of putting on the bolting cloths, nor to interfere with the opening of any one of the bolting chest doors on its hinges. Another important feature in the mill is, that the house is not used for the storage of any grain or offal. All the grain is stored in the large elevator adjoining the mill, and spouted into the mill as wanted. The offal is all spouted into a building for that purpose, also the dust from all cleaners and purifiers, leaving the mill house clean and unencumbered. H. M. Shepherd, of Ashland, Mo., is head miller; W. A. Drury, of Minneapolis, Minn., second miller; D. J. Herstein, of Waterloo, Pa., and Adam Shrader, of Iowa, stone dressers. The engine house is built of stone, 32x40, one story high above ground, and contains all the necessary machinery, furnishing power to both mill and elevator. One thousand and six hundred cubic feet of cut stone masonry is used in making foundation for the engine, which is a genuine "Corliss," made by the Corliss Steam Engine Company of Providence, R. I., 120 horse power, cylinder 18x48 inches, is a high pressure, non-condenser, with Corliss' latest improved cut off. The fly wheel is thirty-one inches face, sixteen feet in diameter, and weighs 16,000 pounds. The total weight of engine is 76,000 pounds.

To supply the necessary amount of steam, two of Corliss' Centennial pattern vertical tubular boilers, four feet in diameter, and fourteen feet long, are used, being, with furnaces, twenty-two feet in height. One of Dean's direct acting steam pumps is used for filling the tank, from which the boilers receive their supply. There is also connected with the pump a stand pipe, extending to the top of mill and elevator, to which hose can be attached in case of fire. At the northwest corner of the engine house stands the smoke stack, ten feet at the base, and tapering until it reaches the height of eighty feet from the surface of the ground. Robert Ulrich, of Manhattan, made the bricks and laid them. The work is well done, and will stand the ravages of time. The office, a two-story frame building, 24x24, is located west of the mill building. The first story is used for office purposes, and weighing of all grain going into the elevator in wagons, a twenty-two foot Fairbanks' scale being partitioned off on the north side, where teams drive on and are weighed. A window being located directly opposite the beam box of scale, enables the weigher to remain in the office at his desk. The second story is used as a store room for sacks and light supplies for mill and elevator. Col. John B. Anderson, treasurer of and largely interested in the company, has given all his time and his personal supervision to the construction of these buildings, and the general "completeness" which impresses one so strongly on looking through the premises is due to his efforts. The company also have an elevator at St. George, Kansas, the machinery used being duplicates of that used in their elevator at Manhattan. They also have a mercantile establishment at that point, for the purpose of furnishing the residents of Pottawatomie adjacent with goods, being modeled after the business house of E. B. Purcell, of Manhattan, and dealing in everything.

SOME NEW SUGGESTIONS IN REGARD TO STEEL.

At the recent meeting of the Institution of Mechanical Engineers a paper was read by Mr. W. Anderson, M.I.C.E., on the subject of a paper on the structure of cast-steel ingots, read by Dr. Chernoff before the Imperial Russian Technical Society.

Chernoff has been for some years assistant manager of the Abouchoff Steel Works, near St. Petersburg. The Abouchoff Works stand supreme in the world as regards the variety of the processes there carried on, and are under the control of the director, Captain Kolokoltzoff, of the Imperial Navy.

In addition to the old casting house, with its 2,000 crucible furnaces, the Siemens crucible furnace, the Bessemer converter, and, lastly, the Siemens-Martin and Whitworth fluid-compressed steel processes, are all to be seen in operation. The forge has a dead-weight 50-ton steam hammer, a 35-ton hammer, and a whole array of smaller hammers. There is a tire mill, and there are extensive workshops for the manufacture of ordnance of every caliber, and of their projectiles, for the production of the heaviest masses in steel, whether for commercial or war purposes, and for the making of gun-carriages. The establishment is provided with an admirable laboratory, with one of Kirkaldy's testing machines, and with every appliance necessary for investigating the nature and properties of the metal which forms the staple produce of the place. With the opportunities which the Abouchoff Works present, and with the aid and encouragement of Captain Kolokoltzoff, Chernoff has produced a series of papers, addressed to the Imperial Russian Technical Society, which have thrown a strong light upon the theoretical, as well as upon the practical, aspects of the steel question. Chernoff is perfectly unhampered by trade jealousies and trade secrets. His reputation in his profession will be increased by making his work as public as possible, and by drawing aside the veil that some manufacturers have studiously wrapped about their processes. The manufacture of guns, especially breech-loading guns of heavy caliber, presents exceptional advantages for ascertaining the internal structure of the steel produced. The bore of the gun is cut out of the solid by means of crown cutters, which gives the opportunity of obtaining samples of the centers of the ingots. The perforation of the slot through which the breech block works enables samples to be obtained at every point in a radial direction; and the surface tool work exposes the outer portions of the mass to the observer. The strengthening rings and hollow projectiles, in like manner,

give great facilities for observing the structure assumed by the metal under various conditions, both of form and dimensions.

Chernoff's first paper of note was read in 1868, but did not come under the writer's notice till 1876. He was then so struck by its merits that he translated it. In this paper Chernoff first lays down the proposition that steel is a combination of pure iron and carbon, and that all other substances must be regarded as impurities more or less pernicious, although the introduction of an extraneous substance may in some cases actually have a beneficial effect by neutralizing the injurious action of some other substance. He next broaches the theory that steel changes its properties as its temperature ranges from zero to its melting point; that up to some temperature *a* steel will not harden; that it may be further raised to a higher temperature, *b*, without undergoing any molecular change; that between temperature *b* and the melting point an amorphous structure is assumed; and that in cooling from the melting point to temperature *b*, the metal will crystallize according to laws which are well known as governing the crystallization of alum and of similar salts. The theory is supported by very clear reasoning and by the evidence of practice on a large scale, and seems to explain perfectly all the phenomena of annealing.

In 1876 a paper was read on "Materials for the Study of the Bessemer Process,"* in which the author's object is declared to be more to make the process understood and appreciated in Russia than to bring forward any facts previously unknown.

In 1878 appeared the paper on the "Structure of Cast-Steel Ingots," which the writer has translated, and which is now published in the "Proceedings." This paper dwells, in the first instance, on the defects met with in steel castings, and investigates their origin; next, the means by which they may be obviated or corrected are discussed; and finally, the question as to whether steel castings need forging or other modes of working in order to give them the tenacity which should be due to the chemical composition of the steel from which they are made. Tables of experiments are cited to show that with proper annealing, in conformity with the principles laid down in 1868, cast steel is fully as tough, tenacious, and ductile as the forged metal.

One result of the investigation of the (Institution) Research Committee on Steel has been to draw attention to the important part which occluded gases seem likely to play in any theory on the hardening and tempering of steel. In treating of the analysis of the gases escaping from the Bessemer converter, as given by Snelus and Tamm, Chernoff remarks on the total absence of hydrogen during the first three to five minutes of the process, and explains the circumstance by supposing that the hydrogen, which arises from the decomposition of the moisture of the air blown in, is at first absorbed by the liquid iron; but that in the course of a few minutes the metal becomes saturated with the gas, and consequently allows it afterwards to escape. This is confirmed by a fact announced by Müller in a recent communication to the German Chemical Society, namely, that his analysis of the gases occluded in cast-steel ingots showed that from 68 to 90 per cent. was composed of hydrogen, the remaining gases being nitrogen and carbonic oxide, the latter in very small quantities. He estimates the pressure of the occluded gases at eight atmospheres.

The astonishing rapidity with which hydrogen passes through red-hot steel, even against the pressure of the atmosphere, has been demonstrated by Regnault. The experiments made by Edison on the evolution of occluded gases from platinum wire, with the consequent hardening of the metal, have led the writer to the theory that the hardening of steel may be due to the escape of hydrogen or other occluded gases during the heating of the steel; the sudden cooling would then prevent their re-absorption, and so enable the particles of steel to approach more closely to each other, thus rendering the metal harder and more dense. But if this view be correct the specific gravity of hardened steel should be greater than that of the same steel before hardening; whereas it is well known that steel "swells" and becomes more bulky when hardened, and its specific gravity decreases. Caron has given very precise information on this subject. The writer, however, considers that the observed reduction of specific gravity is only apparent, and not real, and is caused by the increase of volume due to the fact that the outer layers of the steel, which cool first, are unable to contract, and thus, becoming stretched beyond their elastic limits, receive a permanent elongation which the subsequent contraction of the inner portions is not competent to reduce. According to this view, the strains in a piece of steel, hardened all over, resemble those in a cast-steel ingot, as described by Chernoff. The outer layers are at first stretched, while the inner ones are compressed; but when the steel is quite cold the outer layers are compressed and the inner ones stretched.

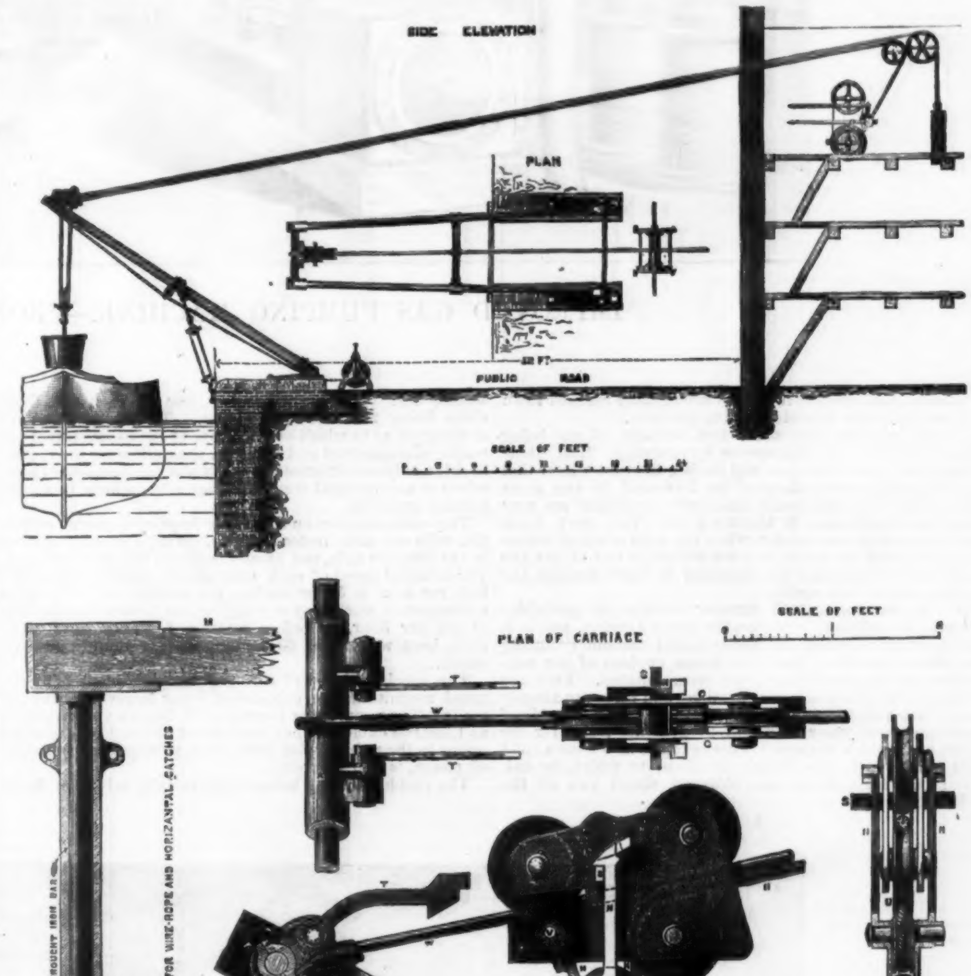
If, however, a piece of steel is hardened from one side only—for example, by cooling it on a slab of cold iron having a thin stream of water running over it—the specific gravity will be found to have increased and not diminished; and, moreover, the bar will have become concave on the hardened side, showing that it has there contracted, and has consequently become more dense. This experiment the author has tried, and has thus been able to verify the statements of Regnault, that the specific gravity of hardened steel, when its particles are free from strain, is greater than that of the same steel before hardening. But the main difficulty is to account for the gradual softening as the hardened steel is slowly heated again. This difficulty has been sufficient to upset the theories of Jullien and others, but the writer thinks that the new theory offers a ready explanation. As the hardened steel is heated the pores are opened; gas is again absorbed, and, when the tempered steel is again quenched, retains the molecules at that precise distance apart by which they were separated when the quenching began. The characteristic colors may also be explained by supposing that the opening of the pores of the metal causes changes on the surface of the steel sufficient to account for the change of color. The theory by which it is commonly sought to explain these colors is that a film of oxide, forming on the surface of the steel, plays the same part as the thin surface of a soap-bubble, or as thin films of tar or oil floating on water. But in the first place, the colors exhibited by steel are not iridescent, but each degree of hardness is indicated by a uniform color; and in the next place, the hues produced by thin films are only observed in transparent bodies, and are caused by the interference of rays of light partly reflected from the upper and partly from the lower surface of the films. But oxide of iron, however thin, is never known to be transparent. Moreover, to produce a given tint, the thickness of the film must be some definite minimum quantity, or else an even multiple of that quantity; but the colors characterizing particular degrees of hardness are constant, though produced under the most varying conditions of time and hardening medium; and it is difficult to conceive that the films should in all these cases always assume one of the several definite thicknesses necessary to satisfy this theory. It therefore seems more probable that a change of surface takes place, and that the colors are due to diffraction rather than to interference. A new and most sensitive instrument for ascertaining the molecular condition of metals has lately been placed in the hands of metallurgists in Prof. D. E. Hughes' "induction-current balance." A description of this instrument will be found in the "Proceedings" of the Royal Society for May, 1879, vol. 29, p. 56. By its means it is possible to detect extremely minute changes of structure, and to compare unknown specimens with any desired standards. In investigations connected with the molecular conditions of steel and other metals chemical analysis is of comparatively little value, and is at best difficult, tedious, and costly to perform; whereas Prof. Hughes' instrument appears to give the means of detecting not only chemical, but also structural, changes of very small amounts.

* Translated *in extenso* in the "Metallurgical Review," New York, 1878, p. 457.

IMPROVED GRAIN ELEVATOR.

WE illustrate below a novel grain conveyor, designed by Mr. Wm. Rennie, and erected by the Newry Foundry Company for Mr. James Fennell, of Newry; it is worked by one man, and is capable of conveying 30 tons per hour from the vessel into the stores. It is simple, considering the work it has to perform, and by no means an expensive arrangement.

In the engraving, M is a wooden frame hinged to a casting fixed to the masonry of the quay wall, so that by inclining it more or less it brings its top direct over the hold of the vessel; through the top of this frame a round bar passes, on which is fitted a socket, A, to which is attached the wire rope, W, also the two catches, T T; the wire rope extends into the store, passing over a grooved wheel, K, and has attached to its end a weight, X, sufficient to bring back the top of the frame, E, when the blocks, D, are slacked. On the wire rope is mounted a little carriage, C, fitted with two brass wheels, I I, to run on the wire rope. It is also fitted with a third grooved wheel, U, over which passes a hemp rope, H, and round the bottom block, U_2, and up to and made fast to an eye, V, in the carriage, C. To the bottom block are attached two catches, N. The hemp rope passes into the store and over a grooved wheel, Y, and round a common crane barrel, B_2. On the barrel axle is a large drum, Q, driven off another drum, G, on the mill shaft, S, which is constantly in motion, and the stopping and starting are effected by a pressure pulley, P, worked by the lever, L. The barrel is also fitted with a brake, O, and ratchet wheel, J. Two buckets are provided, each to hold 10 cwt. The working of the machine is as follows: When a bucket is filled in the vessel the man in the store brings the pressure pulley, P, in contact with the belt, B, which puts the rope barrel, B_2, in motion, the carriage, C, being held in its place above the vessel by the catches, T, until the bucket rises, bringing the studs, N, in contact with the catches, T, and raising them off the square stud, S, which passes through the carriage, by which time the catches, N, come in contact with and rest on the stud, S; then the rope barrel, being still in motion, draws the carriage with the grain up into the store. When discharged the bucket descends the wire rope again by gravity, the attendant governing its velocity by means of a brake, O. Then the catches, T, force the catches, N, off the stud, S, and take their place; and so the bucket, R, is then lowered into the vessel's hold, by which time the men in the vessel have the second bucket ready for hoisting, and so the process is repeated, the action being nearly automatic.—*The Engineer.*



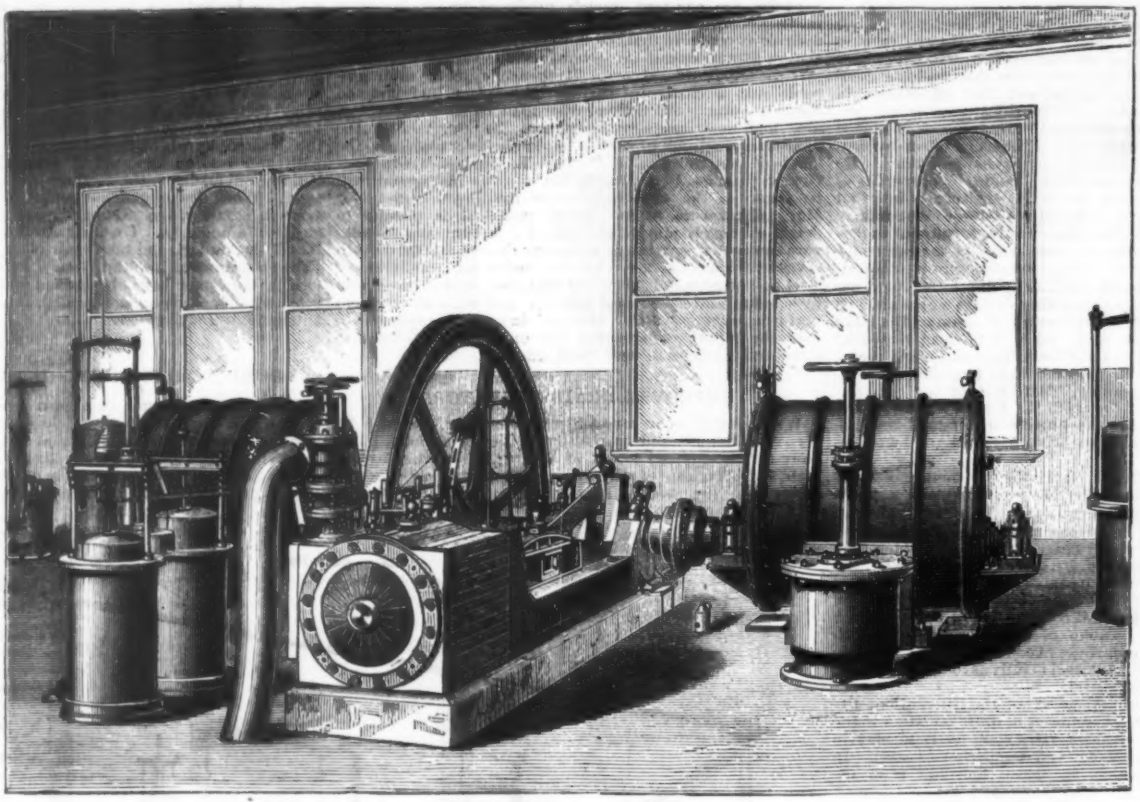
RENNIE'S PATENT GRAIN ELEVATOR.—THE NEWRY FOUNDRY COMPANY, NEWRY, ENGINEERS.

PUMPING GAS DIRECT INTO THE MAINS.

DURING last autumn there were erected at the Beckton Station of the Gaslight and Coke Company—for pumping pure gas from the gasholders at that station to London through the distributing mains—six of the largest exhausters hitherto made. These exhausters, or pumps, were designed for the purpose of utilizing to a greater extent than before the present two 48-inch mains between Beckton and the distributing stations of the company in London, by increasing the pressure of the gas at Beckton as the demand required.

There are three engines, each working a pair of 250,000 cubic feet per hour exhausters, making the total quantity of gas pumped per hour equal to 1,500,000 cubic feet, and these have been in successful operation during the past winter. On some occasions as much as 1,750,000 feet of gas per hour have, during foggy weather, been pumped for successive hours to London. So satisfactorily have the engines and exhausters done their work that very little comparative oscillation of water gauge occurred at Beckton, and nothing perceptible at the distributing stations in London, where the gas was sent direct to the public.

The two mains under the ordinary holder pressure would deliver 1,000,000 cubic feet of gas per hour to London, so that the economical advantages of forcing the gas by the means described are at once apparent, as without the aid of extra pressure the necessary quantity of gas could not have been sent without laying, at heavy cost, a third 48-inch main



IMPROVED GAS PUMPING MACHINE.—FRONT VIEW.

to London, and even then the gas would have reached town at a comparatively low distributing pressure.

It is believed that this is the first instance of gas being supplied direct to the consumers by pumping. The whole arrangement has worked so well during the past winter that the pumping power is about to be increased by one more engine and two additional exhausters, and these are now being made by Messrs. B. Donkin & Co. They are to be in operation before next winter, when the total nominal pumping power will be equal to 2,000,000 cubic feet of gas per hour; and this quantity it is intended to force through the existing two 48-inch mains.

During the spring and summer months the gasholder pressure is sufficient to force the gas to London, and it is only necessary to work the above-named machinery during the winter months. Therefore steam engines of the non-condensing single-cylinder type were selected. They are horizontal, of 40-horse power nominal, and three are already fixed. Each of them is fitted with a feed-pump capable of supplying feed water sufficient to generate steam for the whole of the three engines. These engines also have a solid steel crank-shaft with double bearings, to which, by universal couplings, there are attached direct two of the 250,000 feet per hour exhausters, one on each side, their slides being fixed at right angles. These couplings are so designed as to admit of either one of the exhausters being readily disconnected and laid idle, thus allowing the engine to drive only one exhauster. They also accommodate themselves to any unequal wear that may arise, which is an important provision.

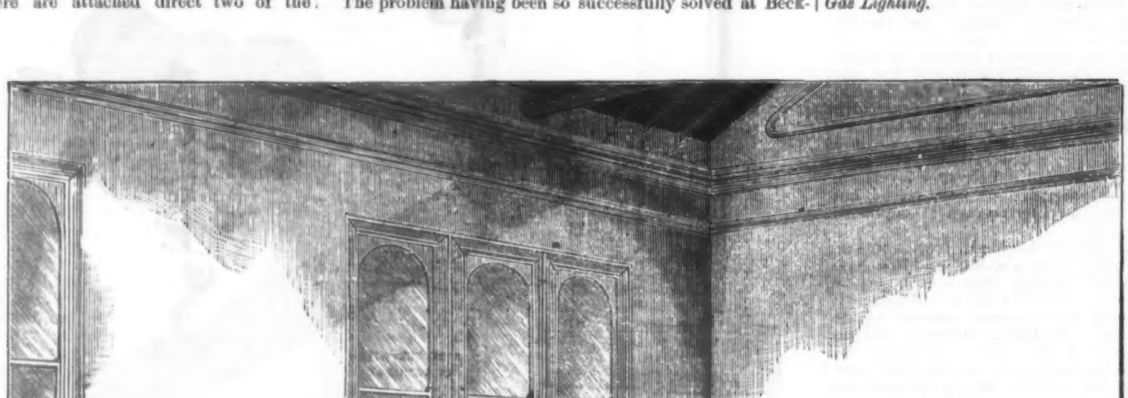
The exhausters are on J. Beale's improved patent principle, with one slide instead of two, giving a greater bearing in the drum or axle, and greatly reducing the wear and tear. The nominal speed of each exhauster to pass 250,000 cubic feet per hour is 50 revolutions per minute, and with eight exhausters at work they would give the 2,000,000 cubic feet of gas per hour, as before mentioned. They have, however, been worked at 60 revolutions per minute and upwards.

The special feature of this gas-pumping plant is its unusual magnitude, the exhausters being larger than any yet made. The pumping or forcing of so large a volume of gas as 1,750,000 cubic feet per hour direct through distributing mains to the public, with little or no perceptible oscillation of gauge, is also a novelty.

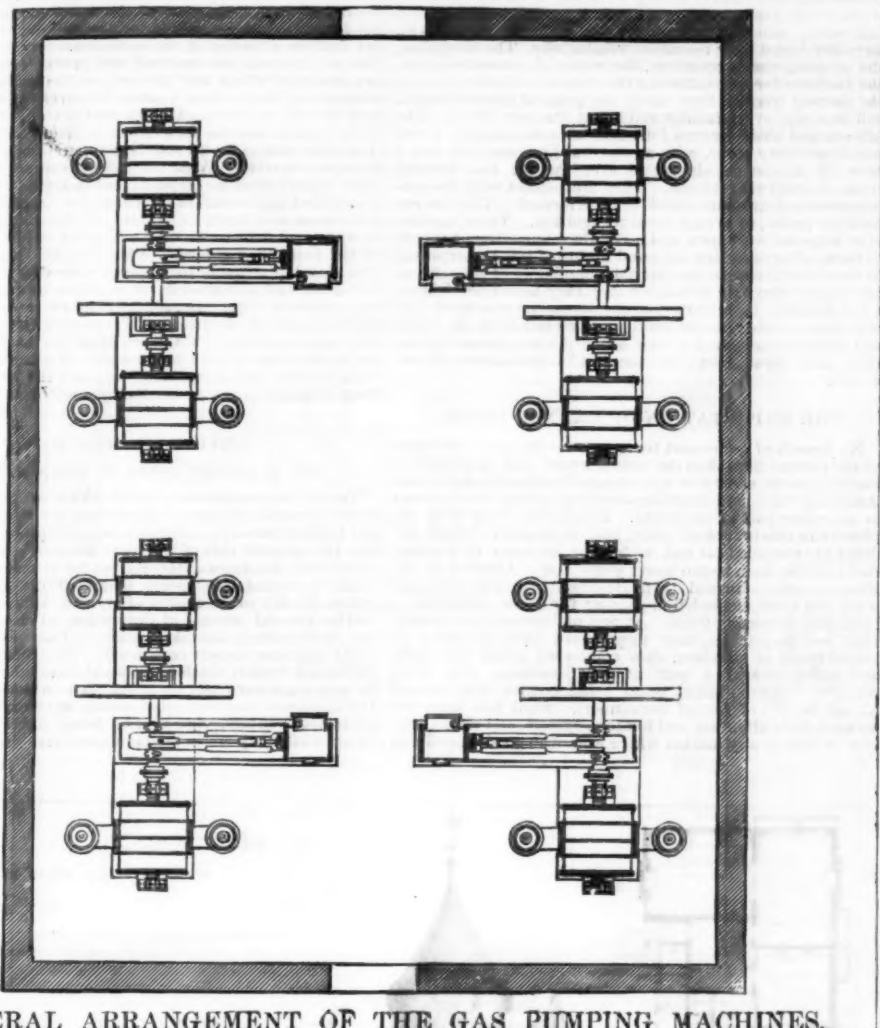
The problem having been so successfully solved at Beckton, it is a question how far the same means may be adopted in other gas works to supply gas through existing mains which have become too small for their work by the increased and increasing demand for gas. In many works it may probably be worth consideration whether it would not be more economical to erect pumping plant similar in character to that we have been describing rather than take up old mains and relay larger ones. This system might also facilitate new gas works being erected some little distance from large towns, and perhaps allow the choice of sites better adapted for the delivery of coal, etc.

We give two views of one of the engines, with its two exhausters attached, showing the method of coupling; also the general arrangement of the exhauster house. To supply steam, there are six two flued Lancashire boilers with Galloway tubes. Only four, however, are required to work at one time when coke is used, but with breeze five are necessary.

The whole arrangement was designed by Mr. G. C. Trewby, M. Inst. C.E., the Chief Engineer of the Beckton Gas Works. The engines and exhausters were made by Messrs. B. Donkin & Co., of Bermondsey, London.—*Journal of Gas Lighting.*



IMPROVED GAS PUMPING MACHINE.—SIDE VIEW.



GENERAL ARRANGEMENT OF THE GAS PUMPING MACHINES.

PRICES OF IRON.

PRICES of iron have fallen so much within a few weeks as to make a considerable reduction in the cost of railroad construction and maintenance. But the sudden fall has not stimulated, but rather restricted, the demand for the present, for the simple reason that buyers fear that, before they need to use the iron, it will be cheaper still—just as they were eager to purchase when prices were rising from week to week. There is a limit below which prices are not likely to fall, however, under the present circumstances, and that is the cost of importation; and it must not be supposed that this cost of importation is likely to become nearly as low at any time this year as it was a year ago, when importations began to be made on a large scale. For, though doubtless a large and probably the chief cause of the advance in foreign iron has been the American demand, we cannot expect that the diminution or cessation of that demand will be followed by a recurrence to last year's prices.

The lowest price at which foreign steel rails have been imported, so far as we know, has been $35; and at that time the current price for ordinary steel rails in England and Belgium was not more than $22. But since that time the cost of production in these countries, as well as here, has increased materially; the iron-master has to pay a good deal more for coal, ore, and wages; and although these will doubtless fall somewhat with lower prices for iron, they will fall slowly, and only under the pressure of great necessity, to the rates prevailing a year ago. Indeed, it must be remembered that the prices then were universally recognized as altogether out of proportion to the cost of production, possible only for the most fortunately situated works, and barely paying expenses at these, the others being generally closed.

It is not likely that the foreign works will be willing or able to supply this country at anything like the prices they accepted a year ago.

As for the domestic production, a considerable element in its cost was fixed for several months when prices were at the highest. The blast furnaces that receive supplies from Lake Superior, and some others, we believe, make their contracts for ore in the winter for the whole year, and at the same time, this year, have contracted for its transportation by lake. This year the prices for both ore and transportation were such as were justified by the winter prices of iron—that is, very high. Thus, with the greatest possible reduction in the profits of the iron works and the wages of their employes, a return to last year's prices or anything like them cannot be expected. Indeed, it is questionable if the American works will not have trouble in meeting the cost of importation, even with very moderate profits. They will, doubtless, do it, however, and it is probable that hereafter imports will be very greatly diminished, and that the American works will substantially supply the home demand; though, for the rest of this year, the chief profit in the business may go to those who supply the ore, and not to those who manufacture the iron.—*Railroad Gazette.*

A CASE OF PERMANENT POLARITY IN STEEL OPPOSED TO THAT OF THE MAGNETIZING COIL BY WHICH IT IS PRODUCED.

By A. RIGHI.

THE author finds that on taking bars of the same steel and of the same diameter but of decreasing lengths, he arrives at a certain length which no longer yields any magnetization, whilst with smaller lengths he obtains a permanent polarity opposed to that of the coil.—*Comptes Rendus.*

PROGRESS OF RAILROAD LAW IN NEW YORK.

THE just published seventy-sixth volume of the New York Court of Appeal Reports contains several instructive decisions illustrating the progress of railroad law in New York. One of them, Thorpe *vs.* The New York Central & Hudson River Railroad Company, relates to the vexed question of the liability of a company in respect to drawing room cars which it does not own. It is well understood that for the most part, throughout the country, the drawing room cars, palace cars, and the like, are not owned by the company owning and operating the road and selling the passage tickets. That company merely draws them, attached to its trains, for the Wagner or Pullman Car Company. Whether this arrangement exists because, when the special cars were first introduced, the railroad companies did not care to risk the investment of purchasing them, but preferred to draw them for the inventors, so that the companies are simply continuing to do as they began, or whether there are substantial reasons for continuing the division of ownership as a permanency, has never been made clear in the courts. The passenger has, in several instances, sued the carrying company for some mishap, maltreatment, loss of baggage, etc., sustained by fault of the drawing room car company's servants. The carrying company has interposed the defense that they were not owners of the drawing room car nor responsible for its management. But we do not recall that in any of these cases, counsel for the company so defending have made any clear, lucid, satisfactory explanation of practical re asons upon which this division of ownership and responsibility is founded. Perhaps, therefore, it is not surprising that the courts have not favored the view of a divided liability. The current of judicial thought has been that passengers cannot be required to discriminate between the railroad company and the palace car proprietors; their arrangements are a matter entirely between themselves.

Thorpe's case forms no exception to this general view. He entered a New York Central Railroad train at Syracuse, without asking for a drawing room car ticket, his purpose being to ride in one of the ordinary passenger cars to Auburn. There were two plain cars attached to the train. He passed through them both, seeking a seat, but could not find one. Most of them were filled with passengers, a few, as usual, with hand bags and overcoats; there were none vacant, and several persons were obliged to stand up or sit upon the wood box for want of seats. One point made in the case was that Thorpe ought to have formally asked the conductor to clear away the hand baggage from one of the seats and assign it to him; but the court said that this is not a passenger's duty; it is the duty of the company's servants to keep the seats available for passengers. Thorpe passed forward into the drawing room car. There was no doorman stationed to forbid him; the objection, taken in some of the cases, that a passenger may not force his way into a car which is guarded under rules of the company, did not arise. He entered the car without opposition, found a vacant seat, and took it. In due time the drawing room car collector called upon him for the extra charge. He declined to pay it; said that he had taken the seat only because the other cars were full; and declared that he was willing to go back to the ordinary car whenever he could have a seat there. The porter of the drawing room car then attempted to eject the passenger from that car by force, and for this assault Thorpe sued the railroad company. The defense made was simply that he had sued the wrong defendant; that the porter was the servant of Wagner, the owner of the drawing room car, not of the railroad company; and that the latter company was in no respect responsible for his acts, even if wrongful. The Court of Appeals decide that the persons in charge of a drawing room car are to be regarded and treated, in respect of their dealings with passengers, as the servants of the railroad company, and that the latter company is responsible for their acts toward passengers to the same extent as if it selected them and paid their wages. In the ordinary management of railroad trains, these cars are mingled with the other cars of the company, are open to passengers generally, are apparently a part of the train, and the manner of conducting the business amounts to an invitation by the railroad company to the public to use them. Passengers cannot know what private or special arrangements, if any, exist between the company and third persons, under which these special cars are run; and a passenger who takes one of these cars has a right to assume that he does so under a contract with the railroad company, and that the servants in charge of that car are its servants. The opinion of the court mentions possible cases of a passenger in one of these cars who should be burned by the negligent upsetting or breaking of a lamp by the porter, and says that he could not be turned over for his remedy to a suit against the proprietors of the drawing room car. The railroad company is responsible to passengers for the entire management of the train and the due performance of duty by all persons employed in it, and must in turn seek reimbursement from the drawing room car proprietors if they are ultimately liable. While corroboration for this decision is drawn from some statutes of the State, the chief grounds are of general application.

Other courts have taken the same view. In a Massachusetts case, decided in 1878, the passenger, by direction of the porter of the Wagner company, left his hand baggage in the car while he went for refreshments; the car was changed during his absence, and his baggage was lost in the transfer. In a more recent case in Ohio a traveler in a sleeping car had his head bruised by the porter's letting the upper berth fall on it, as he was arranging the car for the night, causing partial paralysis. In both cases the passengers sued the carrying company. That company defended on the ground that the action should be against the sleeping car company, and the courts overruled the defense.

Delay in forwarding perishable property gave rise to an interesting decision. Tierney, at Albany, loaded a car with cabbages for the New York market. He obtained the usual way bill or receipt, and took pains to see that the freight agent placed upon the car a placard in these words: "Perishable property; this car must be run to New York by first train: in case of accident or defect of car, reload and forward at once." Notwithstanding this mandate, the car was allowed to lie over at East Albany for two days, and during this delay the cabbages were frozen. The evidence showed, upon the whole, that if the trip had been made promptly, as agreed, the freezing would not have occurred, and that there was no extraordinary disaster or casualty preventing punctual transportation. The best account of the cause of the delay was that the freight business at the time was unusually heavy; that more cars were arriving at East Albany than could be forwarded, and that when the car in question reached East Albany, it was switched upon a side track, where it became blocked by cars subsequently arriving, so that it could not be moved until they were sent forward. The East Albany freight agent said that the reason why the car, notwithstanding its placard, was not sent earlier was, "because he could not get at it." The court held the company liable. It was its duty to transport the cabbages by their first train, unless there was such a pressure of property, likewise perishable, which had arrived before as to make sending by first train impossible. A general accumulation of ordinary freight ought not to excuse delay in forwarding perishable goods; and the opinion intimates the general rule to be, that if a carrier cannot transport all the property which he has received, it is his duty to give a preference to that which is known to be perishable, even over non-perishable property which may have been earlier received. All perishable property must be first forwarded in order of its receipt; non-perishable property naturally and properly waits until the perishable has been sent.

De Graff, a brakeman in the employment of the New York Central & Hudson River Company, was thrown from a moving train, in consequence of the breaking of the chain as he was applying the brake, and brought a suit for damages, founded on the theory that the chain was defective. No distinct evidence was given as to the cause of the fracture or nature of the defect. There is no proof that the chain was not perfect when it was put in place, and there was proof that inspectors, employed by the company, examined the chains frequently, to see that they appeared strong, and also that such chains frequently break, without, as a general rule, causing any serious harm. The decision of the court is, that such a casualty is within the risks and dangers incident to the business which are assumed by an employe. "Railroad corporations," says the Chief Justice, "should be held to a high degree of care and responsibility, but there is a point beyond which these requirements would be unreasonable and oppressive, and would, in effect, make them insurers against all accidents or injuries arising therefrom." And he explains that, as a general rule, the degree of vigilance required is measured by the dangers to be apprehended or avoided. There does not appear to be any practical necessity that the full strength of brake chains should be maintained. Upon a train of, say, thirty cars, it cannot be indispensable that the brake chains upon every car should be perfect, for only a portion of the number would be used in controlling the train. Moreover, the fracture of a chain does not ordinarily or probably involve any serious danger or injury. The company is therefore not liable to a brakeman for an injury received through the breaking of a chain, except upon proof that the company is chargeable with negligence; such as allowing the cars to be equipped with defective or insufficient chains in the first instance, or failing to maintain a proper inspection, sufficient to provide against the decay. The mere fact that the chain appears, from the breakage, to have been at the time insufficient, is not enough to charge the company. It was shown on behalf of De Graff that he was only seventeen years of age, but the court said this could make no difference. It is an element in the contract of employment that the employe bears the risks which are incident to the nature of the work. His youth and inexperience may be important when the question is whether he was chargeable with contributive negligence, or whether the company was in fault for assigning to him a service beyond his age, strength or skill. But a youth who accepts employment in work for which he is competent cannot claim on account of infancy to be relieved from its risks. He assumes the perils inseparable from the service in the same manner as a grown person would do.

A suit against one of the New York City street railroad companies gave rise to an extended discussion of the relative

rights of travelers upon the highway. Adolph was driving a heavy loaded one-horse wagon along Avenue A, and made use of the street railroad track. A car came up behind him moving at an unusual rate of speed. The car driver shouted to him to clear the track, and he immediately endeavored to do so. But before his heavy wagon could turn off completely, the car ran into it and upset it, and the wagon driver was badly hurt. Judge Folger says that there are three classes of ways for travel, the common road or street, the horse railroad, and the steam railroad. The right of the general public to use these is different. In the common street or road, and as respects ordinary vehicles, each member of the public has as a general rule equal right with another; he may drive fast or slowly as he pleases, and is not bound to look back or listen for the approach of faster drivers behind him; but if a faster driver overtakes him, and asks him to let him pass, he is bound to do so if it can be done with safety. The right of the general public to be upon the track of a steam railroad is very restricted. The trains of the company have the exclusive right to use the track as a whole, and the right of the general public is pretty nearly confined to crossing it at a place where it intersects a highway. Even at those spots, the railroad train has the superior right; it is the duty of the highway traveler to look and listen for any coming train. He is not privileged to wait for a signal or request from the engineer before he begins to leave the track clear. He is in duty bound at first to take every care to ascertain that no train is coming, and secondly, having ascertained this, to cross as promptly as he can. The track of a street railroad laid for horse cars holds an intermediate place. Any one of the general public has the right to drive his team and vehicle along the track lengthwise, as well as to cross it at the intersection of streets. But the law accords to the street car company the exclusive right to any part of the track over which, at the time, its horses and cars are passing, or just ready to pass. Private travelers are bound to leave the track to the unrestricted use of the company whenever a car wishes to occupy it. The reason of giving this privilege to the street car company is, that the car is necessarily confined to the track, while carts and carriages can come on or turn off at pleasure. The track is not given to the company in a sense which forbids the use of it by the public. But private drivers who use it are in duty bound to keep watch for the approach of any overtaking car, and to keep themselves in readiness to turn out promptly. They are not entitled to jog along until a car driver asks them to clear the track, but must keep out of the way of the street cars as far as reasonable watchfulness and care can enable them to do so, provided the street cars are not traveling at improper speed. It is not entirely clear how far all the judges concurred in the details of this opinion, and his Honor's definition of the relative obligations of engineer and highway traveler at a steam railroad crossing seems more stringent toward travelers than that which has been expressed in one case by the Supreme Court of the United States. But the case is an interesting contribution toward an important discussion.—*Railroad Gazette.*

THE STORM AND THE RAILROAD.

The last storm has entailed very heavy work upon the force charged with the duty of keeping the railroad open over the Sierra. The feats which are performed every winter by these brave and skillful men are not of the kind which often find eulogistic chroniclers, yet assuredly what they do in these conflicts with elemental forces is as deserving of recognition and recital as the heroism of the battle-field. The quiet dwellers in the valley who stay by their own firesides have no idea of the magnitude of the undertaking in which the railroad men on "the hill" are now engaged. While the welcome rain is pouring upon the fields and giving assurance of heavy crops, the mountains are enveloped in furious snowstorms, and the forces of nature seem allied in a tremendous onslaught upon the daring mortals who have assumed to keep open the communications over the peaks and gorges of the range. The inexperienced traveler who first sees the massive snow-sheds which inclose the track for miles on the mountains is apt to wonder at the apparently useless strength of these structures. The ponderous timbers seem capable of sustaining ten times any imaginable weight that can be put upon them; but their builders know better. For when one of these exceptionally heavy storms has raged three or four days, and rain and snow are interspersed, the drifts upon the roofs of these snowsheds attain so enormous a weight that the huge beams often snap like pipe stems under the pressure, and the whole shed for a distance of hundreds of feet collapses like a house of cards. When casualties of this kind occur gangs of men are instantly brought up from Truckee and other points, and no matter what the hour or state of the weather, the laborious work of clearing the wreck away is begun and carried on without pause until it is accomplished. Meanwhile the storm allows no breathing space for the superintendents, officials, and men who are stationed on the hill. Snowplows must be kept going continually, rushing with all the force of five, six, ten, twelve, or even more powerful locomotives, at the heavy drifts which a few hours will accumulate in any exposed part of the road. Sometimes even this apparently irresistible charge fails, and the snow-plow is brought to a halt, buried deep in the white mass which for all its softness constitutes so formidable an obstruction. And the men who run these plows, and the men who often during heavy storms remain in action for several days and nights without sleep or rest, not seldom take their lives in their hands as surely as if they were going into an actual battle. There are many ugly chances to be encountered in these desperate struggles with Nature, and from time to time some disabled combatant is quietly sent to the rear, and takes his place in the wards of the company's hospital at Sacramento.

But no matter what the dangers, or what the extent of the disasters to be repaired, or the opposing forces to be withstood, the men on the hill never falter or fall back. The sense and realization of duty are as keenly felt among that hardy but modest band as in any "fighting" corps of a victorious army. And their work is essentially soldierlike in its spirit. It is a real positive combat with the storm in which they are engaged, and the ultimate triumph over all obstacles and accidents which is embodied in the terse dispatch, "Road open again all through," or some such words, is undoubtedly as genuine and well-earned as any exultation over the conquest of a difficult position in the field of arms. The work these men are habituated to, moreover, is training on the mountain division a corps of self-reliant, active, indomitable officials, whose like can probably not be found on any other railroad in the world, since no other railroad has the same problems to solve. It is beyond question a superlatively useful education they are receiving, and unconsciously to themselves they are being fitted for executive work of the highest order. The long, hard fights with wind and snow, which almost every winter forces upon them, have developed their resources wonderfully. The discipline, the system, the precautions, the means of communication, the facilities for concentrating the largest available force in the shortest possible time upon the point of special danger, call into play every faculty and talent that war elicits. The officers and their veteran followers are consequently a real miniature army corps, with an *esprit* as high and real and a love of danger as sincere as ever the far less harmful trade of soldiering breeds. They are content with the consciousness of arduous duties well performed. They do not look for praise, or even general recognition. Their business is to keep the road open, and no doubt it sometimes happens to them, after spending days and nights of toil and exposure in their work, to hear the peevish complaints of thoughtless passengers who only remember that they have been delayed a few hours in their swift journey across the continent, and who have neither realization nor appreciation of the perils and labors undergone for their benefit by the unboastful but alert and loyal men "of the hill."—*Sacramento Record-Union.*

THE EXPORTATION OF CANNED GOODS.

No branch of our export trade is attracting more attention at the present time than the manufacture and shipment of canned goods, since it is very generally acknowledged that American fruits and vegetables excel in quality those grown in any other part of the world. France has long been the pioneer in this branch of trade, and the fame of French sardines has extended far and wide, the business of canning them having been begun many years ago. Afterwards the French canners turned their attention to mushrooms and peas, and have succeeded in gaining for these specialties a large and increasing trade. At first our canners put up only fruit and vegetables, then they turned their attention to potted meats of all kinds, then condensed goods like milk and coffee formed a part of their business, and more recently, "Boston baked beans" and codfish balls helped fill out the bill of fare of the canners. Shell fish have not escaped their attention, and lobsters, oysters, and clams, may now be had in any market where American goods are offered for sale. Both temperate and tropical fruits are put up, so that all tastes may be gratified, while they may be served at any season of the year in the cheapest possible manner.

We need not, however, speak of the various sorts of goods now put up in this country, both for home and export trade. The vast quantity of goods put up in every part of the country, from the sweet corn of Maine to the salmon of Oregon, as well as the low price at which they are put upon the market, makes competition by foreign canners almost an impossibility. Take for example, the large canning factories situated on the Columbia River, which forms the boundary between Oregon and Washington Territories. Their business consists in putting up salmon which are caught in vast quantities by the Indians. The fish are sold at a very low price by the natives, and are delivered in the finest possible condition, and are among the finest of canned goods put up in this country.

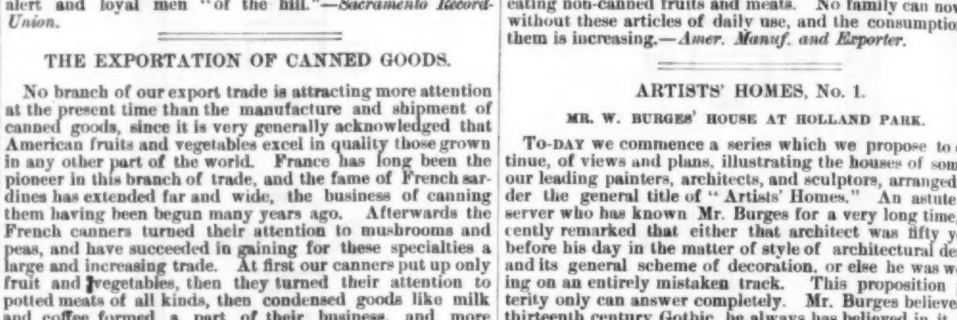
In Florida, at the present time, the putting up of guava jelly is becoming quite a branch of business, while in Texas, the amount of meat put up in cans is simply enormous. Even that most common of vegetables, which almost every farmer grows in his corn field, the pumpkin, is now put up, while pumpkin flour has obtained a reputation equal almost to the new process brands made from the finest of spring wheat. The American dealer can put his goods on the market at astonishingly low prices, and in all American cities canned goods are sold so low, that oftentimes it would seem as if the price asked would hardly pay for the cans alone. Our great competitor is Australia, but even that wondrous land of wheat, wool, and gold will doubtless be distanced in the close competition of American dealers. Low prices and good quality are the maxims of the American manufacturer of to-day; hence our goods of whatever kind sell beyond all rivalry.

The business of putting up oysters, the finest variety of our shell-fish, attracted but little attention, and old canners shook their heads in doubt at the new departure, but at the present time the Baltimore packers have more orders than they can fill, and even Baltimore peaches and tomatoes become of secondary importance compared with the delicious bivalves. In view of the vast trade in this class of goods now assuming such large proportions, is it any wonder that the attention of the agricultural press of Europe is directed towards our rich soil and products, as well as the low prices at which they are put on the market? The ingenuity of the average Yankee is proverbial, and the same may be said of our packers of eatables of whatever kind. Even such relishes as horseradish is put up for export, while American pickles have a standard reputation in almost every European market. What the canner cannot do the evaporator endeavors to accomplish, and thousands of bushels of evaporated apples and other fruits are annually put up for both home and foreign markets. By bleaching, the fruit is as white and delicate as a flake of snow, while all the juices of the fruit are retained. What new field the packer will now develop remains to be seen, since everything that can be put up and preserved in tin or wood seems to have been experimented with. Great care is taken in sealing, so that but few cases of sickness are reported by the consumers of the goods; certainly not more than ordinarily arise from eating non-canned fruits and meats. No family can now do without these articles of daily use, and the consumption of them is increasing.—*Amer. Manuf. and Exporter.*

ARTISTS' HOMES, No. 1.

MR. W. BURGES' HOUSE AT HOLLAND PARK.

To-day we commence a series which we propose to continue, of views and plans, illustrating the houses of some of our leading painters, architects, and sculptors, arranged under the general title of "Artists' Homes." An astute observer who has known Mr. Burges for a very long time, recently remarked that either that architect was fifty years before his day in the matter of style of architectural design and its general scheme of decoration, or else he was working on an entirely mistaken track. This proposition posterity only can answer completely. Mr. Burges believes in thirteenth century Gothic, he always has believed in it, and he acts conscientiously up to the faith which he professes. His buildings, however, have mostly had to suffer under one great disadvantage, viz., that of being judged as examples of art while they are in an incomplete state, simply because



their completion, depending so largely as it does on decoration, must be the work of time. The house which Mr. Burges has erected for himself in Melbury road, Holland Park, and which we illustrate above, is intended as a model modern house of moderately large size in the thirteenth century style, built to show what may be done for nineteenth century every-day wants, with that mode of design and form which Mr. Burges considers second only to Greek architecture, a style which he holds to be unsuited in every way for English wants and manners. Mr. Burges' house, therefore, must, in a special sense, be considered as a trial piece, or rather as a sample of what its author and owner would like to see more generally followed. By the plan which we give, it will be noted that the kitchen and offices are in the basement, the ground floor being occupied by the three reception rooms, and hall with staircase. The general outline of the planning is square and simple, giving symmetrically proportioned rooms, and an exceedingly quiet outline to the exterior. The elevations are executed in red brick, with stone lintels and sills to the windows, cornices, and gables. The roofs are covered with green slates and red ridge tiles. The only external carving is the bass-relief over the library windows in the garden front, and the gargoyles to the eaves of porch and back gable. Those who only know the house from the view we now give of it will have but a small idea of the rich and complete way in which the interior is finished. The entrance and garden doors are of solid bronze, inlaid with silver, having alto-rilievo representations of the four ages of man in the former, and a figure of the Blessed Virgin with Child in the upper panel of the latter. The letter box flap in the side wall has a small figure of Mercury, enriched in his dress by inlaid silver letters. The hall is decorated with light red lines in square and constructional forms, with large size figures of the sun and moon enriching the end walls. The pavement is in marble mosaic enlivened with figure subjects, while the large window which lights the hall and gallery over is fitted, like the rest of the windows throughout the house, with painted glass of the most beautiful character. The subjects in the hall windows illustrate the four periods of the day, repre-

seated by female figures issuing from clanging bells, which proclaim the passage of time as the planets represented mark its progress. The fire-place, like those in the dining and drawing rooms, is hooded, and contains a dog grate. The dining-room is lined with a dark marble dado, the upper parts of the walls being intended for tile decorations, with the idea of making the room washable, so to speak. The two cabinets on either side of the fire-place contain many choice specimens of Mr. Burges' designs in the way of dining-table silver, and service, a cistern in copper being provided for the supply of water, in which the more valuable and delicate articles may be washed without being removed from the room. Spaces are left in the marble dado for bronze-framed pictures which will be let into the walls. The decorations of the library are completed, and a very splendid effect is undoubtedly obtained. The fire-place is in onyx, having an elaborately carved cornice over in highly painted and gilded stone, illustrating the letters of the alphabet, and figures representing the several parts of speech. The library book-cases are enriched with painted panels, chiefly by Mr. Weeks, the figure subjects being taken from the building trades, which follow the letterings which mark the cupboards, thus, for example: A was the architect, B was the bricklayer, etc. The fun and humor of some of the figures is very interesting, especially the pompous strut of the distinguished R.A. Some of the panels in the other parts of the room were painted by Leighton, Burne Jones, Holiday, Albert Moore, and Stacey Marks. The lower parts of the windows are glazed with plate glass in metal casements, and clear glass is also preserved in the groundwork of the upper lights where the painted glass occurs. A granular surface is obtained on the walls by rough canvas, on which gold diapers of varied design are painted. The ceiling of this apartment, like the others throughout the house, is boldly framed with massive beams and countersunk panels, but is here simply enriched with lines of color, the main body of the work showing the wood as it left the joiner's hands. The drawing-room is divided by a columned opening, hung, like all the door openings, with rich hangings, running doors also being in this case used. The fire-place in the drawing room may well be described as the gem of all the work and design found in the whole house, so charmingly is it conceived and finished, with a series of admirable figures ranged between a conventional treatment of trees, the foliage of which forms the foliation of the cornice. The ceiling is to be richly decorated with figure subjects, like the frieze running round the room. The windows here, like those throughout the house excepting the guest chamber, are provided with a double set of spring roller blinds instead of shutters, one set being made of richly embroidered moleskin fabric which is perfectly opaque, so that a thoroughly decorative feature is made of the blinds themselves. The staircase is contained in the turret seen in our view, which we may here remark is from particulars taken on the spot with the material assistance of a fine photograph, taken by Mr. Bedford Lemere, of the Strand. The windows are richly colored, and the soffit of the stairs is decorated after the manner of the hall, over which runs a projecting gallery communicating with the bedrooms. Mr. Burges' bedroom is immediately above the library, and here bright red is the groundwork of a vigorous scheme of color, in which the ocean and its inhabitants form the figure subjects for wall and ceiling decoration. The hooded mantel is enriched with a large mermaid, whose head, turned from the light, obtains that which her mirror reflects full in her delicately carved face, which by this means obtains a brilliant prominence. The guest chamber over the dining-room is simply a magnificent apartment, so gorgeous are its colorings on a groundwork throughout of gold, on which brightly painted flowers in natural tints and renderings are made to play a most important part. The colored glazing of the windows through lattice work of Eastern character completes the story. It is here that Jennings' patent tip-up basin is to be seen, cut out of a solid marble block, and inlaid with gold and silver fish, like that in Mr. Burges's own room. A cistern over forms the water supply instead of the usual water jug, and for taps the most grotesque figures in bronze, set with jewels, play their part. The other principal apartment on this floor is the armory, in which Mr. Burges' well-known collection is arranged. On the upper floor are the Monkey and Jack the Giant-Killer hooded fireplaces, the former being in the room known as the night nursery; and the latter as the day nursery; but the owner having thus far remained unmarried, the small occupants usually found in such apartments are conspicuous, at Melbury road, by their absence. The other rooms are devoted to maids' rooms, and the kitchens and offices are in the basement. The gardens are laid out with raised borders, having dwarf brick walls, and some large marble benches ranged round a mosaic paved terrace, in the center of which is a carved statue, form a prominent feature at the back of the house, where the richly-wooded expanse of Holland Park completes the background.—*Building News.*

LINCOLN CATHEDRAL MISERERES.

OUR examples are from sketches of casts by Mr. T. F. Pennington, as given in the *Building News*, the selected subjects being some quaint misereres of the Decorated period, from the choir stalls in Lincoln Cathedral. Other designs will be found in the back numbers of the SUPPLEMENT.

SEEING BY ELECTRICITY.

WE hear that a sealed account of an invention for seeing by telegraphy has been deposited by the inventor of the telephone. While we are still quite in ignorance of the nature of this invention, it may be well to intimate that complete means for seeing by telegraphy has been known for some time by scientific men. The following plan has often been discussed by us with our friends, and, no doubt has suggested itself to others acquainted with the physical discoveries of the last four years. It has not been carried out because of its elaborate nature, and on account of its expensive character, nor should we recommend its being carried out in this form. But if the new American invention, to which reference has been made, should turn out to be some plan of this kind, then this letter may do good in preventing monopoly in an invention which really is the joint property of Willoughby Smith, Sabine, and other scientific men, rather than of a particular man who has had sufficient money and leisure to carry out the idea. The plan, which was suggested to us some three years ago more immediately by a picture in *Punch*, and governed by Willoughby Smith's experiments, was this: Our transmitter at A consisted of a large surface made up of very small separate squares of selenium. One end of each piece was connected by an insulated wire with the distant place, B, and the other end of each piece connected with the ground, in accordance with the plan commonly employed with telegraph instruments. The object whose image was to be sent by telegraph was illuminated very strongly, and, by means of a lens, a very large image thrown on the surface of the transmitter. Now it is well known that if each little piece of selenium forms part of a circuit in which there is a constant electromotive force, say of a Voltaic battery, the current passing through each piece will depend on its illumination. Hence the strength of electric current in each telegraph line would depend on the illumination of its extremity. Our *receiver* at the distant place, B, was, in our original plan, a collection of magnetic needles, the position of each of which (as in the ordinary needle telegraph) was controlled by the electric current passing through the particular telegraph wire with which it was connected. Each magnet, by its movement, closed or opened an aperture, through which light passed to illuminate the back of a small square of frosted glass. There were, of course, as many of these illuminated squares at B as of selenium squares at A, and it is quite evident that since the illumination of each square depends on the strength of the current in its circuit, and this current depends on the illumination of the selenium at the other end of the wire, the image of a distant object would in this way be transmitted as a mosaic by electricity.

SUGGESTIONS IN DECORATIVE ART.

A more promising arrangement, suggested by Prof. Kerr's experiments, consisted in having each little square at B made of silvered soft iron, and forming the end of the core round which the corresponding current passed. The surface formed by these squares at B was to be illuminated by a great beam of light polarized by reflection from glass, and received again by an analyzer. It is evident that, since the intensity of the analyzed light depends on the rotation of the plane of polarization by each little square of iron, and since this depends on the strength of the current, and that again on the illumination of the selenium, we have another method of receiving at B the illumination of the little square at A.

It is probable that Prof. Graham Bell's description may relate to some plan of a much simpler kind than either of ours; but in any case it is well to show that the discovery of the light effect on selenium carries with it the principle of a plan for seeing by electricity.

Scientific Club, April 21.

JOHN PERRY.
W. E. AYRTON.—*Nature.*

A CORRESPONDENT of the *Dirigo Rural* says that one bushel of sugar beets mixed with nine bushels of apples makes a cider richer and of a superior flavor to that made from apples alone, and that sugar beet juice can be converted into vinegar in the same manner as cider.

AN ELECTRIC RAILWAY.

THE council of magistrates of the city of Berlin had under consideration a few days ago a proposal, submitted by the firm of Siemens & Halske, for the construction of an electric railway across a portion of the capital. The line would start from the Bell Alliance place, and run through Fredrich and Chaussée streets on to the Wedding place. There will be two lines of rails, one for the up and the other for the down journey. The viaduct will be carried on iron pillars 14 ft. 9 in. high, and nearly 33 ft. apart. These pillars will be placed along the edge of the footpath, so as to cause the least possible interference with the ordinary traffic. The carriages will be narrow and short, containing ten sitting places and four standing places. The electro-dynamic machine which will propel the carriages will be placed under the floor of the carriage between the wheels, and a steam engine of 60 horse power, which will be employed in the production of the electricity, will be placed at the terminus. The stoppages will be very few, and the rate of speed will be, it is expected, about 20 miles an hour. The chief object of the undertaking is to convey persons quickly across the city, and especially to facilitate access to the city line of railway. The chief objection raised is that the carriages will pass along at the level of the first floor of the houses in the streets which it will traverse, and it is feared this will lead to a depreciation of property. The magistrates have appointed a special commission of engineers and architects to examine into and report upon the proposal.

STEWART'S ELECTRIC LAMP.

THIS is a self-regulating lamp, capable of burning for a very long time without attention. It is simple in construction, inexpensive to manufacture, and, as the consumption of carbon is less than in most regulators, it may be said to be economical.

A general view of this lamp is shown by the figure. The action of the arrangement is as follows:

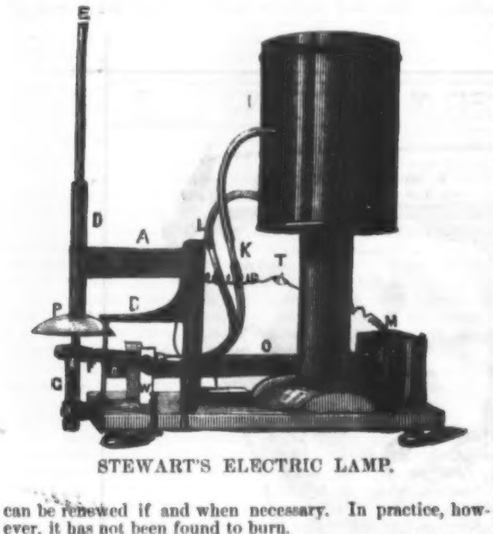
The binding screws, R and S, being respectively in connection with the positive and negative poles of the dynamo machine, the current enters at R, passes along the support, A, through the wire, T, and the electro-magnet, M, then back through the wire, U, the support, B, and spindle, C, to the binding-screw, S.

The armature, N, being momentarily attracted by the magnet, M, pulls on one side, by means of the lever, O, the metal electrode, F, which forms a ring round the carbon rod.

There is a flow of water through the electrode, F, which latter works on a central spindle, C. The electrode, F,

being now in contact with the carbon-rod, E, the current changes its direction in the following manner: it passes from R along the support, A, through the metal tube, D, to the carbon-rod, E. The carbon-rod, E, may be of great length, so as to burn for a considerable time without renewal. The electric arc is formed between the inside edge of the ring electrode, F, and the carbon-rod, E, passing from E to F, and thence by the spindle, C, to the binding-screw, S. As soon as contact is established between the electrodes, E and F, the armature, N, is released, and the electrode, E, is forced back to its normal position by means of the spring, Q. The upright, W, is to prevent the electrode, F, going too far. G is a piece of insulated carbon to keep the carbon-rod, E, from falling; its position can be regulated by means of a screw. I is a small cistern, from which water flows through the metal electrode, F, to keep the latter cool. K and L are flexible tubes, which convey the water to and from the cistern, the circulation being maintained by the different levels at which these tubes enter the cistern. P is a reflector to throw the electric rays downward.

The electrode, F, is easily attached to the spindle, C, and



STEWART'S ELECTRIC LAMP.

can be renewed if and when necessary. In practice, however, it has not been found to burn.

An advantage which this lamp possesses consists in the ease with which the carbons can be renewed when consumed, as they have merely to be dropped into the tube, D. The carbons, indeed, need not be in long lengths, as pieces a few inches long may be piled one on the top of the other in the tube, and each piece will come into use as the one beneath it becomes consumed.

The arrangement of the different parts of the lamp, as shown by the figure, are not, perhaps, as compact as they might be, but this is simply due to the fact that the figure given is that of a trial lamp. The details could easily be modified without altering the general principle, which possesses points of novelty which seem highly advantageous.

It might be imagined that the water in the cistern would become heated quickly, and would require constant renewal. Such, however, is not found to be the case; a comparatively small volume of water is found to cool the electrode sufficiently to protect it from injury.

This lamp, which is not patented, is the invention of Mr. Charles Stewart, M.A., of 50 Colebrooke Row, London, N.

ON THE DISRUPTIVE DISCHARGE OF ELECTRICITY.

By Alex. Macfarlane, D.Sc., and P. M. Playfair, M.A.

During the months of November and December of this session we have investigated certain questions suggested by the results already communicated to the society.

Difference of Potential required to pass a spark between (1) two equal spherical balls at different distances, (2) a plate and ball at different distances, and (3) a plate and point at different distances.

A series of observations was taken for each of these, and on three successive days, without altering the arrangement of the apparatus or the charge of the electrometer. The couple of small Leyden jars were attached to the conductors of the Holtz machine, as we had previously found that it was impossible to observe the discharge between a plate and point with any degree of accuracy when the capacity was small.

Two Balls, each of two-thirds inch diameter.—The series of observations for the two balls is a more minute and extended investigation of a problem we took up and solved approximately before. We have observed more minutely the values of the readings at the smaller distances, and also noted the cause of the irregularity at the ends. We found that at 80 mm. small violet sparks began to pass before the principal white spark, and that the reading was then more ambiguous than for smaller distances. Escape from the conductor was first noticed at 120 mm.*

Plate and Ball.—We employed a tin plate 8 inches diameter, and one of the brass balls used in the previous experiment. The curve obtained is not very different from that for the two balls; it is somewhat more circular. Small sparks passing before the large one were observed to begin at a shorter distance than in the previous case. Another irregularity at the end was due to the passing of two large sparks. Finally, the electricity began to escape from the insulated wires.

Plate and Point.—The plate used was the tin plate of the previous experiment; the point was conical and of brass. From 1 to 5 mm. the discharge was in the form of a white spark; for higher distances nothing was visible excepting a glow at the point. The series was continued up to 200 mm., as there was no difficulty due to escape of the electricity into the air.

Discharge through a Solid Dielectric.—We obtained, by favor of Mr. Calderwood, of Addiewell Chemical Works, a quantity of a pure solid paraffin of low melting point. The plate electrodes were separated to a distance of one-third inch inside a glass vessel, the liquefied paraffin poured in so as to cover the plates completely, and then allowed to solidify for twenty-four hours. When the plate electrodes were charged the first spark which passed was large, and illuminated the whole of the paraffin, but the succeeding discharges were much smaller and of equal amount. The first spark produced a deflection 3·6 times as great as the succeeding sparks. When the plate of paraffin was examined afterwards it was found to be perforated in a zigzag manner, the hole being surrounded by char. We found that—

Electric Strengths.

Air	1
Paraffin when solid	5
Paraffin when liquid	2·5

Thus the electric strength of this substance when in the solid state is to its electric strength when in the liquid state as 2 to 1.

As an instance of how these experiments may be made directly useful, I may mention that we obtained two samples of liquid paraffin from Mr. Calderwood to compare their electric strength. We found the ratio to be 1:6. It is, however, extremely difficult to effect the comparison unless we have a considerable quantity of each specimen. It is best to have a dish of the above form, where we can have broad plates, the lower one slightly raised above the glass bottom, and the upper one well immersed in the liquid. The former of these conditions helps to prevent solid particles getting in between the plates, and the latter prevents the rising of the liquid up the stem, and consequent splashing about of liquid particles.

Discharge through Paraffin Vapor.—We put the discharging vessel, with a quantity of one of the pure liquid paraffins, inside the receiver of an air pump, exhausted the air, and allowed the paraffin vapor to accumulate. When the barometer gauge indicated 50 mm. pressure, the distance being one-third inch, we took sparks through the vapor. The spark was of a broad section, green at either end, but of a deep violet between. When a quantity of air was let in white jagged sparks were observed in the midst of the colored spark. From the readings obtained at 50 mm. pressure we infer that this paraffin vapor is 1·7 times as strong as air.—*Proceedings Royal Society of Edinburgh.*

* Hence the irregularity previously observed is not due to the escape of electricity into the air, but to the passage of small sparks between the electrodes.

PHYSICAL SOCIETY, LONDON.

Meeting, April 10, 1880.

THE HUMAN EYE AS AN AUTOMATIC PHOTOMETER.

By Mr. William Ackroyd, F.I.C.

It is difficult to get the value of a very intense light in terms of a weak one, because the relative physiological values of the similarly colored constituents are unknown. The author's experiments were made to show that the eye itself is a fairly good light measurer. When a "spot" or star of light is looked at from a distance, it is seen to emit "rays" or spokes of light at all angles. These are due to the radiate structure of the crystalline lens and the lachrymal fluid on the surface of cornea of the eye. The rays are of various lengths; and are shorter in the first and second quadrants, next the nose or near the blind spots than on the third and fourth quadrants, a fact probably due to the insensibility of this region. The iris expands and contracts under the stimulus of light independently of the will, and both irises act sympathetically. Now, the iris lies between the seats of irregular refraction, and thus any change in the size of the pupillary aperture will be rendered evident by an alteration in the length of the longer rays of a spot or point of light. On this fact is based the use of the eye as an automatic photometer. The sensitiveness of the iris varies in different persons. The author finds that a sperm candle burning 120 grms. per hour produces a distinct movement of his iris when 14 yards distant. In employing the eye as a photometer the author adopts the principle that if the light from one source, A, falling on the eye is capable of producing movement of the iris at a distance, *d*, and the light from a different source, B, is capable of producing the same movement at the distance, *d'*, then the relative intensities can be found from the squares of these distances. To carry this out in practice the observer is in the dark, and an artificial star is placed on a level with the eyes at a fixed distance. Below this place the light to be tested in the same plane. While gazing steadily at the star the other light is to be eclipsed and revealed, and the observer is to find a position where the revealing of the second light does not influence his iris, as shown by no apparent shortening of the rays of the star taking place. He then approaches gradually till a second position is reached, where the revealing of the second light *does* produce a movement of the iris. The distance between this position and the light, *d*, is measured. A third light is now put in place of the second, and the same observations repeated so as to get a second distance, *d'*. From these distances the relative intensities are calculated. The author's results agree pretty closely with those of Rumford's photometer; but he found that for some reason the first two observations have to be discarded as too inaccurate. Owing to the sympathy between the two irises these experiments were binocular. This sympathy may prove convenient in constructing an eye-photometer, since one eye can be turned to the light to be estimated, while the other is looking at the artificial star. This method of photometry would be too delicate for comparing powerful electric lights unless aided by mechanical means, which, however, the author hopes to supply.

Electrical Experiments.—Prof. Ayrton then offered an explanation of the experiment shown by Prof. Guthrie at last meeting, to the effect that while flannel rubbed with ebonite was + electrified, and ebonite rubbed with glass was +, flannel rubbed with glass was —. Prof. Ayrton accounted for this apparent anomaly on the grounds that one or more of the substances was an electrolyte. Glass, for instance, is an electrolyte, and a battery had been made from it. Experiments made by Prof. Perry and himself had shown that in a "pile" made up of divers substances, one or more of which were electrolytes, though the rest were metals, the electromotive force of the pile was equivalent to the algebraical sum of the several "pairs" composing it; but it was not equivalent to the electromotive force of the first and final plates made into a pair. That could not be predicted from the contact electromotive forces of the elementary pairs. When only metals were employed it could, but not in cases where an electrolyte entered. This same result would apply to Prof. Guthrie's frictional experiments. In answer to Prof. Guthrie's question whether electrolysis did not come into play in Prof. Ayrton's experiments, Prof. Ayrton replied that it could not operate to a greater extent than in Prof. Guthrie's experiments, as he had used a quadrant electrometer.

New Tonometer.—Dr. Stone then described a new tonometer, devised by Prof. Rudolf König, which he had recently seen in Paris. It consisted of a clockwork working into a tuning-fork, which produced no less than 128 escapes per second. To this clockwork, originally invented by an assistant of M. Breguet, and exhibited at the Paris Exhibition of 1856, Prof. König has added a Helmholtz vibration microscope moved by the clock, and the fork whose vibration-number is to be measured is placed vertically in the focus of the microscope. The apparatus is very portable and no loading of the forks is required. Prof. Hughes observed that he had patented a vibrating regulator in 1856.

Collodion Electric Machine.—Dr. Guthrie then exhibited an electric machine, formed of a collodion disk rubbed with cat's fur and giving negative sparks. The collodion, after a suggestion of Capt. Abney, was put on by giving a disk a coat of collodion, then a coat of India-rubber dissolved in benzol, then a coat of collodion again. Prof. Guthrie also showed that an iron cylinder revolving round its longer axis, and with a current flowing in a wire parallel to it, has power to deflect a magnetic needle.

Prof. Ayrton stated that he had found the mere rotation of an iron cylinder produce the deflection in question, and therefore thought the current was not required to produce the effect shown.

Distribution of Atmospheric Pressure.—L. T. De Bort calls attention to the fact that, in two columns of air which have the same pressure at the surface of the ground, if the temperatures are different, the decrease of pressure at higher levels is slower in the warmer column. Hence results a tendency of the air to pass from the warmer to the colder column, accompanied by a falling barometer in the former, and a rising barometer in the latter. The effects of difference of temperature being generally opposite to those of barometer pressure, the transfer of air may be effected in the upper atmosphere, even when the pressure is lower at the bottom of the column. The ocean currents, in winter, augment the energy of the atmospheric disturbances by increasing the opposition which already exists between the continental and oceanic temperatures.—*Comptes Rendus.*

THE THEORY OF THE GELATINE EMULSION PROCESS.

By Dr. H. W. Vogel, of Berlin.

Gelatino-bromide of silver plates, which have lately come so much into use, possess many properties presenting important variations from those of collodion plates—variations which, at first sight, seem to be inexplicable or, at any rate, are not easily accounted for on generally accepted principles.

1. It is well known that, in the case of *collodion*, the silver bromide, prepared with an excess of silver nitrate, is decidedly more sensitive than that prepared with an excess of the alkaline bromides. With *gelatine* plates, on the other hand, the emulsion prepared with an excess of silver nitrate not only shows no greater sensitiveness over that prepared in the other way, but also exhibits so many defects (for example, the appearance of red fog), as to render questionable its practical value.

2. In *collodion* plates prepared with excess of soluble bromide, there is, moreover, observed a very marked elevation of the sensitiveness when pyrogallic acid, gallic acid, tannin, and other similar substances are flowed over them. *Gelatine* plates, on the contrary, so far as my own experience goes, show no corresponding signs of improvement, under certain conditions, except in the solitary case when pyrogallic acid is used.

3. *Collodio*-bromide of silver emulsion does not obtain an increase of sensitiveness from the addition of ammonia, whereas the sensitiveness of *gelatino*-bromide is doubled by it (Eder).

4. In the presence of chemical sensitizers—such as silver nitrate, morphia, gallic acid, etc.—*collodio*-bromide is rendered sensitive to the yellow, red, or green rays by means of certain pigments; in *gelatino*-bromide this action of pigments is only observed in a very slight degree, as recent experiments have served to convince me.

5. *Collodion* emulsions do not become more sensitive by long-continued emulsifying; the sensitiveness of *gelatine* emulsions is wonderfully increased by this means.

These divergences are so large that, if originally we had known of gelatine emulsions only, our views on the photochemistry of silver bromide, etc., would have been radically different. How, then, are we to explain these apparent contradictions?

Foremost in importance we have to consider the *substance* of which the film is composed. Now, to all appearances the collodion film is chemically quite inactive—I put out of the question here decomposition, which may be set up in the course of time, and have an injurious effect on the latent image. Pyroxyline is not affected by tannin or silver nitrate; with gelatine the circumstances are different. As we know, the latter is tanned by contact with tannin, and becomes altogether altered in character; it is changed into a leathery mass, which is with difficulty penetrated by a liquid such as the developer. The obstacle it thus presents to the process of development quite overcomes the favorable action of tannin produced during exposure.

Similar is the case if we employ silver nitrate in excess. This substance forms with gelatine a compound which cannot be decomposed even by long-continued washing in water, so that an appreciable quantity of silver nitrate remains in the washed emulsion. An excess of silver nitrate in the gelatine, therefore, acts in the same way as an excess of nitrate in an insufficiently washed collodion emulsion; that is, it gives with the alkaline developer a fog, and this fog completely ruins the favorable influence of the nitrate during exposure. Besides, nitrate of silver has the effect of making the gelatine horny (Dr. Lohse).

Morphia, which is a good sensitizer of collodion plates, acts unfavorably on gelatine plates; probably this is due to some reaction on the gelatine. In this respect the behavior of gelatine with each separate sensitizer must be studied alone, in order to be able to judge what will be its effect on gelatine emulsion plates. Since, then, if the action of so many sensitizers on gelatine plates is a very slight one, it is not surprising that there is no very perceptible action of the coloring matters which renders silver bromide in collodion sensitive to the red, yellow, etc., rays; for, as I have before had occasion to explain, the action of these coloring matters

depends essentially on the presence of the sensitizers under consideration.

Now, up to the present, it has not been found possible to make a collodion emulsion of equal sensitiveness with one of gelatine, either by means of long-continued cooking or by the addition of ammonia. This fact can be explained by reference to the different modifications to which silver bromide is subject, according to the investigations of Stas. The eminent Belgian chemist has described a highly sensitive form of the bromide of silver produced by continuous boiling of the salt in water for many days together. It is so sensitive that exposure to the flame of a Bunsen burner for a couple of seconds is sufficient to produce blackening, and so finely divided that it remains suspended in water. Similar to the effect of boiling in water, as stated by Stas, is the long-continued stewing of the gelatine emulsion. Now, cooking a collodion emulsion has not the same beneficial effect, but this is due to the fact that, in this combination, the silver bromide exists in another and denser condition, which cannot be changed to the finely-divided modification of Stas. That such conditions really exist has been proved by Dr. Szekely; he precipitated bromide of silver from an aqueous solution containing glycerine, according to Abney's formula, washed it, and then emulsified it by stewing it with gelatine. By this process he obtained a very uniform emulsion, which had about the same sensitiveness as that of wet plates and which was not rendered more sensitive by cooking for several days.

It thus appears that the bromide precipitated from an aqueous solution has different properties from that produced by precipitation in gelatine. Similar properties, however, are apparently possessed by silver bromide precipitated in an alcoholic solution. Silver nitrate is known to be very scarcely soluble in alcohol, and the small amount dissolved in that liquid has the tendency, especially in the presence of ether, to become insoluble and to precipitate in tolerably large particles. No wonder, then, that the silver bromide precipitated from such a solution should be thrown down in a denser condition than is the case in an aqueous solution. Owing to this state of density, the decomposition of salt by the action of light, and by that of the developer, is hindered, and thus may be explained the want of sensitiveness. Personally I feel sure that, by some contrivance, it will be made possible to obtain the silver bromide in a finely-divided condition, and to incorporate it with the collodion.*

We come now to another point for consideration, namely, the color of the bromide. Stas states that the finely-divided pearl-white bromide of silver is immediately turned to a deep yellow color on contact with ammonium bromide. This change of color goes hand in hand with the absorption of light, and only that kind of light which is absorbed acts chemically on the silver bromide. Now, since yellow bromide of silver absorbs blue light much more powerfully than white, it will also exhibit greater sensitiveness to the blue rays. In this way the physical properties of silver bromide may have an effect on its sensitiveness. There is, however, the condition that the salt must remain in a finely-divided state. Should the bromide, when it assumes the yellow modification, be rendered coarser in grain, its facility for reduction of development will be lessened, and for this reason its sensitiveness will be affected.

There is still a point to be considered: gelatine which has become partially decomposed by long cooking acts appreciably as a sensitizer. Dr. Lohse has observed that, when gelatine alone is cooked for a long time and then used for making an emulsion, the latter is found to be very sensitive.†

In the experiment of Dr. Szekely above described, it must be confessed this sensitizing power of the gelatine has no effect; this, however, is caused by the silver bromide being present in a coarser state; and, according to Dr. Eder's observation, it will not be rendered finer, but rather coarser, by longer continued heating.

The longer the gelatine emulsion is cooked the greater will be the quantity of the products of decomposition; and it seems to be highly probable that these products, like all the results of spontaneous decomposition of organic matter, have a reducing action. There is also another cause: both Dr. Eder and Dr. Lohse have proved that ammonia is formed when a solution of gelatine is kept hot for a long period of time. Now, when ammonia comes into contact with a substance capable of reduction, it acts as an alkaline developer; that is, in this case it reduces the bromide of silver. It is well known that even silver bromide which has never been exposed to the light is gradually attacked by an alkaline developer. Hence also it arises that, after very long-continued emulsification, an emulsion will give plates liable to fog.

Berlin, April 1, 1880.

EXPANSION OF PAPER.

It is tolerably well known to most persons that paper when wetted expands, and also that it contracts again when dried; but it is not so well known to many that its expansion is always greater in one direction than in the other. Thus, if a sheet of paper be cut exactly square and then wetted, it will be found to measure more in one way than it will in another. This property often gives rise to difficulties when mounting prints that have to be joined or matched in size.

Some few years back we published in our pages the fact that a photograph printed on paper cut from the sheet in one direction would, when mounted, be of a different size from a print cut the other way, although both were printed from the same negative; that is, prints made on paper cut lengthwise from the sheet will, when wet, be of a different size to those made on it when cut crosswise. Therefore, it will be found impossible to match them accurately when they have to be joined in mounting, which is frequently necessary.

With a view to elucidate this matter further we have recently made a series of experiments with a number of different samples of paper, selecting only such as are employed in photography either for silver or carbon printing. It is to the latter process that the importance of this subject is the greatest, inasmuch as it is now more extensively employed for large work than the former, and, consequently, on account of the size, any variation will be more manifest. We may here state that nearly all papers now in the market—certainly all those used in photography—are made in continuous lengths, to be afterwards cut up into sheets of the requisite size. It becomes important, therefore, to know which way the sheet is cut from the roll—whether longitudinally or transversely; for, as we shall presently show, upon that depends the amount of expansion.

The first paper we experimented upon was thick Saxe. This paper is made in continuous lengths of half a mile or more, and about fifty-five inches wide. This width allows of three sheets, eighteen inches wide, being cut, and the edges of the outer sheets trimmed off. The water-mark, "Steinbach, Malmedy," appears at short intervals down both edges of the web, so that it may always be known which way the sheet was cut by looking for the water-mark. This, of course, will not be seen on those sheets that are cut from the middle, but it may always be assumed that the longest way of the sheets are cut lengthwise from the roll. Two strips of exactly twenty-four inches in length were taken, the one cut lengthwise and the other crosswise of the web. They were soaked in cold water for half an hour, then laid very carefully on a sheet of glass and measured, and it was found that the strip cut across measured twenty-four inches and three-eighths, while that cut lengthwise was a quarter of an inch less, showing that it had expanded only to the extent of one-eighth of an inch, and the other had to three-eighths.

The same experiment was repeated with different kinds of paper, such as those employed for transfer paper in carbon printing. One of these was a very fine sample of paper of foreign manufacture and very close in texture. This did not expand in any appreciable degree in the length, while in the width it did to the extent of a full quarter of an inch. Another sample—a commoner variety, although a paper of good quality and of home manufacture—did not expand any more than the previous one did in length, although it did to the extent of three-eighths in width.

Two other samples—both of a very hard and close texture—were next tried, and they were found not to expand at all in the direction of length, and only a quarter of an inch in width. Each of the above samples could be stretched considerably without breaking, the Saxe most of all, doubtless on account of the long fiber of the pulp of which it was made.

All the strips were placed in warm water for the purpose of seeing if that would make any material difference in the expansive property; and we found that it did, for after a quarter of an hour's soaking each of the pieces that had been cut transversely from the web in each instance had lengthened an eighth of an inch more, although those cut longitudinally were in no way affected. We noticed, however, that in all cases the paper could be stretched much more after the treatment with hot water than it could before. We had no difficulty in making the sample of Saxe measure twenty-four inches and three-quarters, and we have little doubt that a twenty-four-inch print on that paper cut across the roll might, with care in mounting, be made to measure an inch more; so that it will be seen it is quite possible with a portrait on twenty-four-inch paper to make a life-size head a third of an inch larger—that is, if it were on the transverse way of the web.

Our next experiment was with a hand-made paper with long fiber; in fact, one of the round, gray filter papers so well known to most photographers. Each sheet of the larger sizes of these is made separately, and not cut from larger pieces. We took one of these and cut it down to exactly eighteen inches in diameter, and then carefully saturated it with water, placed it on a glass plate as before, and found that *it* had expanded equally in *all* directions to the extent of half-an-inch. All the samples were then dried and again measured, and the filter paper was found to contract to its original size exactly; but in all the other samples those cut from the roll transversely were about an eighth of an inch longer than at first.

From these experiments it will be seen that paper cut with the length of the roll practically does not expand at all. This fact should be borne in mind by those who have to produce photographs that have to be joined in the mounting, which is frequently necessary in the case of large copies of maps and charts. When two or more prints have to be joined, and it is found that one is longer than the others, the longest should always be fastened down first. The others may then generally be stretched sufficiently in the mounting to make them match—at least at the junction. Advantage may also be taken of mounting one dry and the others wet, or by using (say) starch for the one, which would cause it to expand, and a solution of gelatine containing a large proportion of alcohol, which has no such property, for the other. With a little judgment, and the adoption of one or other of these dodges, prints of slightly different sizes may be made to match near enough for most purposes.—*Br. Jour. of Photography.*

DETECTING FREE HYDROCHLORIC ACID.

By PROF. NICOLA REASE.

THE author finds that a solution of ordinary phenol treated with ferric chloride takes an amethyst coloration, turning to a brown. But if a drop of hydrochloric acid is added to the solution the liquid either assumes no coloration at all or assumes a greenish tint. He proceeds as follows: 1 grm. of the crystalline phenol of commerce is heated in 100 c.c. of pure water. He then pours 1 c.c. of the liquid ferric chloride into 50 c.c. of pure water. This solution being in a small test beaker set on a sheet of white paper, the solution of phenol is added drop by drop. The first drop, if the solution is slightly acid, produces a fugitive coloration, but if it is strongly acid no color appears. On continuing to add the phenol solution the color becomes permanent and gradually darkens. From the volume of the phenol solution consumed an approximate idea of the quantity of acid present may be formed.

DECOMPOSITION OF POTASSIUM PERMANGANATE BY OXYGENATED WATER.

By M. BERTHELOT.

THESE two compounds, if brought in contact in a strongly acid liquid, are reciprocally decomposed, losing all their active oxygen, and being reduced to the state of protoxide. This change is due to the formation of an unstable compound, whose spontaneous destruction explains the consecutive evolution of oxygen. This new colorless compound is stable at —12° in the medium where it is produced, but is destroyed on assuming the ordinary temperature. The author regards this compound as a hydrogen teroxide formed by the oxidation of oxygenated water by potassic permanganate. It is analogous to several peroxides and metallic acids, and to hydrogen tersulphide.

ON PORTLAND CEMENT.*

By MR. WATSON.

PRESUMING that the members of this society are not so conversant with the history of the manufacture of Portland cement as with that of soda and its compounds, I will venture to preface this short paper with a biographical sketch of the former, commencing at its birth.

In the year 1824, Mr. Joseph Aspdin, of Leeds, in the county of York, master bricklayer, made application at the Patent Office to protect a process for making cement or artificial stone for stuccoing buildings, water-works, cisterns, or any other purpose to which it may be applicable, and which he called Portland cement. The process of manufacture described in his specification is as follows:

"I take the specific quantity of limestone, such as that generally used for making or repairing roads, and I take it from the roads after it is reduced to a puddle or powder; but if I cannot procure a sufficient quantity of the above from the roads, I obtain the limestone itself and cause the puddle or powder, or the limestone, as the case may be, to be calcined.

"I then take a specific quantity of argillaceous earth or clay, and mix them with water to a state approaching impalpability, either by manual labor or machinery. After this proceeding, I put the above mixture into a slip pan for evaporation, either by the heat of the sun, or by submitting it to the action of fire or steam conveyed in flues or pipes under or near the pan till the water is entirely evaporated. Then I break the said mixture into suitable lumps, and calcine them in a furnace similar to a lime kiln, till the carbonic acid is entirely expelled. The mixture so calcined is to be ground, beat, or rolled to a fine powder, and is then in a fit state for making cement or artificial stone."

Although Monsieur Vicat, the eminent French chemist, as well as others had succeeded in producing hydraulic cement, closely akin to Aspdin's Portland, long before the date of his specification, and that also by the admixture and burning together of various calcareous and argillaceous substances, there is little doubt that the manufacture of the material known as Portland cement dates from that epoch when Mr. Aspdin filed his specification. How he discovered that the scrapings of the Yorkshire roads could be turned to such good account, there is not evidence to show, but we have proof sufficient that these scrapings when subjected to the manipulation of the observant Yorkshireman, became the pioneer of an important branch of manufacture.

Almost at the same time that Aspdin was experimenting and accomplishing great things with his road mud, Sir C. W. Paisley, of the Royal Engineers, who was stationed at Chatham, was exercising his mind and making elaborate experiments with a view of improving his knowledge of mortars for building purposes, and after sundry trials and failures, he succeeded in making cement identical with Aspdin's Portland, but produced from the chalk and clay of his locality.

Thus, it is curious to observe, Portland cement had its birthplace, although Aspdin had the honor of christening it, in two different places almost simultaneously, and while one inventor secured his raw materials from the hard calcareous and argillaceous formations of the Oolitic system, the other supplied himself from the soft cretaceous chalk strata and the slimy fluviatile accumulations of the post-tertiary period.

Portland cement, like most other young and tender things, was subjected in its early youth to the fierce winds of criticism, and the severe and biting blasts of prejudice, but, as is usually the case when a good thing is offered to the British public, it quickly gained reputation and waxed strong in favor, year by year increasing in demand up to the present, and I think I am under-estimating when, taking last year's statistics as a guide, I calculate the present production in England to exceed *half a million* tons per annum. The contagion for making Portland cement has likewise spread beyond the shores of the British Isles, a considerable quantity being now made at various places on the Continent where suitable materials are procurable.

Until very recently the process adopted and the machinery employed in the manufacture of Portland cement have varied very little indeed; the *modus operandi* may be described in a few words. The chalk and clay are thoroughly mixed in a pug or wash mill with a large proportion of water amounting to three or four times the weight of the materials. After being well and carefully incorporated, this liquid slurry is pumped or conveyed by other mechanical means to becks or settling ponds, where the heavier portion of the slurry subsides, leaving the superincumbent water necessary for the mixing on the top; this settlement takes many weeks to complete, the water is gradually drawn off, leaving a substance technically called "slip" at the bottom of the beck. This slip is then conveyed by barrows and spread on flats, where it is dried, the requisite heat being derived from coke ovens built beneath the flats. When the moisture is all evaporated, the dried material is removed and loaded into kilns adjoining, fuel being added sufficient for the requisite amount of calcination, the waste heat and gases being liberated through the chimney or sugar loaf cone of the kiln, which few will have failed to observe who have ever been in the vicinity of a Portland cement manufactory. After the important process of calcination is completed, the clinker is drawn from the kiln, conveyed to the mill, then ground by horizontal millstones and is ready for the consumer.

To those who have been able to follow this rough description it will be apparent that the aim of the cement maker is, in the first place, to secure a thorough and uniform mechanical incorporation of the raw materials he has to deal with; secondly, to preserve or sustain that intimate relationship during the drying process; and, thirdly, to induce perfect and equal chemical combination of the component parts by the application of heat.

It is almost needless to remark that, of course, the primary step is the selection of raw materials suitable for manipulation, and then to decide upon proportions necessary for a successful result, which can only be arrived at by a careful chemical analysis. The object of the cement maker is to produce a mechanical mixture of carbonate of lime and silicate of alumina, the proportions of which are so evenly balanced that only sufficient lime is present to enter into chemical combinations with the silica and alumina in the clay, and produce a double silicate of lime and alumina.

Although the method of manipulation described is still extensively adopted, yet, like all other devices of man, it is crowded with imperfections, and among the multitude of these shortcomings a few may be mentioned. The chalk usually employed does not vary either in chemical proportion

* Dr. Wolfram, of Dresden, has patented a process which seems to point in this direction.

† My own experience is that boiling the gelatine is by no means so effectual in increasing the sensitiveness as keeping it hot at a comparatively low temperature for a long period of time. This I attribute to the fact that the products of decomposition of gelatine at a high temperature are different from those produced in a lower temperature.

* A paper read before the Newcastle-upon-Tyne Chemical Society, February 26, 1880.

or specific gravity to any extent, but the alluvial deposits are not so uniform in their character. A formation of clay has been found to vary continually, more particularly as regards its specific weight, or rather the weight of the particles composing the formation. Take as an instance the uncombined silica, which is present more or less in every alluvial deposit. The high specific gravity of these uncombined particles as compared with the other substances present, naturally causes them to separate from the remaining portion of the conglomeratic mass, when the agitation of the mixing process ceases, unless the solidity of the mixture is sufficiently dense to hold those silicious molecules in suspension. A percentage of uncombined silica is not an objection in the process of cement making, provided the proportion is not in excess, the particles are not coarse, and the quantity is equally diffused throughout the mixture. These varying properties in weight lead to serious results in the settling becks, unequal subsidence occurring, thereby rendering a perfect chemical combination in the process of calcination impossible.

Another difficulty presents itself in the serious wear and tear and continual dilapidation of the drying flats, in consequence of the unequal and sudden expansion and contraction of the floor, unavoidable when subjected to the influence of the heat given off from the coke ovens beneath, and the frigid temperature of the semi-liquid slurry when deposited on the floor above.

The liberation of the waste heat given off from the kilns, without an attempt at utilization, is also unquestionably an imperfection.

I have drawn your attention to the shortcomings of the cement maker, with the hope that you will appreciate a hasty description of some improvements which have recently been introduced in the manufacture of Portland cement.

Johnson's patent chamber kiln most effectually annihilates two of the objections just referred to, inasmuch as it takes the place of the extravagant flats and coke ovens, and serves to utilize the waste heat given off from the kiln. Mr. Johnson's invention consists of a kiln of the ordinary construction; but, instead of being surmounted with the usual cone, through the top of which the waste heat is liberated, it is arched over, forming a crown of semicircular shape. One side of this arch is continued with a flat bottom, in a horizontal direction, forming a semicircular flue of chamber, supported on tiers or groundwork. The waste heat from the kiln traverses the length of this flue, and eventually escapes through a chimney at the further end. When the kiln is charged, the liquid slurry from the wash mill is pumped or conveyed through pipes to the top of the flue or chamber; these pipes are furnished with outlets through which the slurry flows, dropping through manholes on the roof of the chamber, and finally depositing itself on the floor of the same, which is composed of ordinary concrete.

Sufficient material having entered the chamber requisite for the re-charging of the kiln, the manholes and other apertures are closed, the kiln is fired, and the heat evolved, passing over the slurry in the flue or chamber, thoroughly dries the material ready for the re-loading of the kiln. Thus the heat given off from one charge is made to dry the slurry requisite for the re-loading. The chamber is constructed of sufficient height to enable a workman to move about in it conveniently.

When describing the process of mixing the crude materials in the wash mill, I mentioned that a large proportion of water is necessary to secure thorough amalgamation. As this large amount of water requires to be drawn off again through the agency of the objectionable subsiding ponds, or by evaporation where the patent chamber kiln is employed, it is obvious that any system which will insure satisfactory results, and at the same time will allow the manipulator to dispense with a large proportion of this water, is very valuable. Goreham's patent system possesses this advantage. Mr. Goreham subjects the materials to a process of wet grinding, which takes the place of washing. The chalk and clay are thrown together into a mill exactly similar to the old-fashioned arrangement, but instead of being reduced to a liquid with the usual large proportion of water, they are brought, by the addition of only one-third their weight of water, to a consistency just thin enough to flow out of the mill. But as this mixture contains a large proportion of coarse particles of the aggregates, which require further reduction, the mixture is passed through horizontal millstones.

By this process the particles are speedily reduced to an impalpable paste of sufficient solidity to render the intermediate process of settlement unnecessary, and the evaporation in the patent chamber an easy task.

Several cement manufactories have recently adopted the combined processes of Johnson's chamber kilns and Goreham's wet grinding, with results far exceeding their most sanguine expectations, and can it be wondered at? When new appliances are introduced in the process of any manufacture, the adoption of which results in the economy of fuel and labor, as well as greatly diminished space requisite for manipulation, the advantage gained by the manufacturer must be considerable; but, if these economical changes can at the same time insure *higher perfection* in the *quality* of the finished manufacture, the value of those appliances cannot be over-estimated.

In conclusion, I would remark that since these improvements have been introduced, rendering the difficulties previously referred to things of the past, and imparting to the manufacturer almost absolute control over the varied physical changes of the crust of the earth, I am led to believe from experiments, and the practical experience of others as well as myself, that the day is not far distant when, aided by the chemist, the geologist, and the engineer, Portland cement makers may seek a wider field for their raw materials than the oceanic deposits of the chalk system and the alluvial clays of the tertiary period.

REDUCTION OF NITRATES DURING METALLIC SUBSTITUTIONS.

By DR. GIACOMO GUETTA.

THE metallic nitrates, if heated with a metal capable of substituting itself for the metal of such nitrates, are partially reduced to ammonium nitrate. This reduction the author considers is in great part due to the heat liberated during the substitution of the metals, and which is capable of effecting, in the presence of the electric element formed by the two metals, the decomposition of the water, and of communicating to the hydrogen resulting from such decomposition the power of deoxidizing the nitric acid and converting the nitrogen into ammonia.

DYEING RECIPES.

THE following recipes we have translated from foreign sources. We reproduce them under the impression that many of our readers may be interested in knowing what is being done on the Continent, and of course we wish it to be understood that we give no opinion as to their practical value:

Black on Cotton.

For 100 lb.: 1st, Boil cotton and dry. 2d, Put through pyrolignite of iron (black liquor) at 3½° to 4° Be. for one hour. Lift, leave on sticks over night, and dry in stove. 3d, Put through cold chalk bath and rinse thoroughly. 4th, Dry with 5 lb. dry extract of logwood, 1½ lb. fustic extract (liquid), and 6 lb. sumac. Enter cold and heat gradually, in order to reach 55° to 60° C. after one hour. Next rinse well and dry.

Blue Black on Cotton.

For 100 lb.: Prepare a bath containing for every 100 gallons 36 gallons black liquor, at 10° Be., and 18 gallons red liquor, at 10° Be. Work one hour in this bath, lift, leave on sticks till next morning, dry. Pass through chalk bath, wash well, and dye with logwood alone, or in connection with fustic, or sumac and fustic. Enter cold, heat gradually, in order to reach 110° to 140° F. after one hour; finally rinse and dry.

N.B.—It is always necessary to dry cotton before mordanting. Dry in stove at a medium temperature, heat for five to six hours. The chalk bath is not absolutely necessary, but will be found very useful. A little soda added to the logwood bath will be found beneficial.

Yellow on loose Cotton, to stand milling.

Prepare bath with 25 lb. extract of bark (quercitron), and 15 lb. sulphate of alumina. Boil cotton one hour, then add 3 lb. tin crystals. Boil half to three-quarters of an hour, lift out, wash, etc. The bath may be used for fresh lots, only of course for less material.

COLORS FOR PRINTING ON WOOL.

(From *Muster Zeitung fuer Faerberei, etc.*)

Black.

1 kilo. logwood extract, at 12° Be. (1,000 grammes make 1 kilo.), 164 grammes starch, and 400 grammes dextrine, are well boiled, and to the boiling paste is added 50 grammes alum, 100 grammes acetate of indigo, at 12° Be., and 300 grammes nitrate of iron, at 48° Be.

Red.

1,875 cubic centimeters cochineal solution at 6° Be., and 156 grammes starch. Boil and add 13 grammes tin crystals, and 25 cubic centimeters berry liquors, at 5° Be. Mix well and use.

Violet.

Boil 2½ liters logwood decoction, at 2° Be., and mix with 188 grammes cochineal ammoniacale, 68 grammes alum, and 38 grammes indigo carmine, to be thickened with 750 grammes gum arabic, and 95 grammes muriate of tin added when cold.

Grey.

1 liter water, and 35 grammes starch. Boil and add 56 cubic centimeters logwood extract, at 6° Be., and 56 cubic centimeters bimas, at 6° Be. Boil and when still hot add 5 grammes nitrate of iron, at 40° Be., and 8 grammes sulphate of zinc.

The following have been specially contributed by a practical dyer.

Dark Green on Loose Wool.

For 120 lb. clean wool, 4½ lb bichrome, and 4½ lb. argol. Boil one-and-a-quarter hours; rinse well in cold water. In a clean pan boil the following for ten minutes: 25 lb. fustic, 11 lb. logwood, 25 lb. bright madder, and 35 lb. mill madder. Cool, and enter wool; boil one-and-a-quarter hours, or to shade required.

Rupert Brown.

For 120 lb. loose wool, 4½ lb. chrome, and 4½ lb. argol. Boil one-and-a-quarter hours; rinse wool well in cold water. In a clean pan boil 8 lb. ground fustic, 8 lb. camwood, 10 lb. bright madder, 10 lb. mill madder, and 12 lb. ground logwood. Enter wool below boiling point; boil one-and-a quarter hours, or to shade required.

Risset or China Orange, on Woolen Yarn, 36 lb.

1¼ lb. chrome, 1¼ lb. argol. Boil one-and-a-quarter hours; rinse well in cold water. In a clean pan boil 5 lb. ground fustic, 4½ lb. bright madder. Enter yarn below boiling point; boil one hour, or to shade required.

Drab, on Woolen Yarn.

For 30 lb. woolen yarn 1 lb. bichrome, 1 lb. argol. Boil one hour; rinse well in cold water. In a clean pan boil for ten minutes 1½ lb. fustic (ground), 1 lb. bright madder, 5 oz. ground logwood. Boil one hour, or to shade required. —*Textile Manufacturer.*

NEW COLORING MATTERS.

WE mentioned some time ago an alizarine carmine. This dye, which is obtained by treating dry alizarine with strong sulphuric acid, does not seem to have made much progress in the dyehouse, apparently on account of the opposition manifested by dyers to substitute it for madder; moreover, its high price has doubtless also been in the way. As it has been found possible to produce a good carmine from alizarine of lower quality and at a cheaper rate, hopes are entertained that this new product will find extensive applications in wool dyeing, for the production of thoroughly fast shades. Alizarine carmine finds very strong competitors in the naphthol scarlets of much cheaper cost, but it has the advantage over them of much greater solidity.

For dyeing with carmine the wool has to be mordanted with 10 to 15 per cent. alum, and 6 per cent. tartar. Boil one hour, leave to cool, rinse, and dye in bath containing 8 to 12 per cent. carmine of alizarine at 18 per cent. Add to dye bath 50 per cent. tartar of the weight of color used, and dye at the boil for one hour. Instead of tartar, bisulphate of soda may be used; this gives a fiery madder red. A yellow shade is obtained when to the alum bath another of 10 per cent. tin crystals is added, in which the goods are worked for one hour at 140° F., and dyeing with only half the amount of color.

Violet shades, by using for 100 lb. wool, 2 lb. bichrome and 4 lb. tartar, for the mordant. Violet black shades with 5 lb. copperas, and 4 lb tartar, or 15 lb. chrome alum, and 6 lb. tartar.

We have seen in the *Teinturier Pratique* a splendid sample of blue on cotton yarn. It is produced by preparing the cotton in a boiling soap bath, containing 15 lb. soap for 100 lb. of cotton; it is left there for one hour, then taken out, wrung out, and dried; then comes into the dye bath prepared as follows: In the boiling bath dissolve 50 lb. alum and 12 lb. soda ash, and necessary amount of coloring matter (sky blue) previously dissolved. Enter cotton, work well, then leave in bath till dry.

We should recommend this method for dyeing with soluble aniline blues, for, although rather expensive, it gives very bright shades.

We read that Dr. W. H. Gregg, of Elmira, N. Y., has discovered a new yellow coloring matter from camphor, which he calls *laureline.*

The new product is said to be absolutely fast against all tests, and capable of easy application on linen, cotton, wool, or silk, giving very brilliant shades.

A good yellow having all the properties claimed for *laureline* is a great desideratum, and we hope ere long to hear more about it.—*Textile Manufacturer.*

GUM LAC FROM ARIZONA.

By J. M. STILLMAN.

THERE was received lately at this university, sent by Mr. John A. Culbertson, of Phœnix, Arizona, a quantity of a substance of resinous character, forming a coating of considerable thickness on the twigs of a plant called in that neighborhood "Greasewood," but which I am assured by Prof. Hilgard and by Dr. A. Kellogg is the *Larrea Mexicana.* The plant was identified by means of leaf, flower, and seed sent by Mr. Culbertson. The specimens were gathered in the vicinity of that place on the 22d of December last.

The form of occurrence is precisely the same as that in which the gum lac in India is said to occur, as a coating of hard, brittle resin of a reddish color. The gum lac from Siam is said to occur sometimes in deposits of a quarter of an inch in thickness. None of these specimens are so thick, but some exceed ⅛ inch in thickness, and most are of nearly that thickness.

The gum lac of India is of cellular structure, and in these cells are developed the ova of the insect (*Coccus lacca* or *C. ficus*) whose puncture is said to cause the exudation. These cellular cavities contain at the proper season a red substance, which probably serves as the food of the young insects and in which the eggs are deposited.

The specimens from Arizona exhibit the same structure, and in working with the gum the fingers were frequently stained by the crushing of the pulpy substance of blood-red color, in which the eggs could be readily perceived with the lens or microscope.

The following characteristic properties of the gum lac, given by various authors, have been found to be also properties of the specimens examined by me.

(1) Contains a red coloring matter, partly soluble in water (and resembling cochineal). I found 3 per cent. of such coloring matter by one method, 1·4 per cent. by another method given below. (2) Partly soluble in alcohol with a reddish color. (3) Almost entirely soluble in dilute caustic alkalies with a deep red color. (4) The resin of the gum lac (shell lac) is soluble in dilute borax solutions on heating with a purplish red color, and the solution has a peculiar sweetish odor. The resin of this product also is soluble in dilute borax solution, the color is a little brighter red and the odor a little stronger than in the case of the shell lac, but this may be owing to the greater freshness of the Arizona product, as the shell lac used for comparison was at least four or five years old. (5) The lac resin softens at comparatively low temperatures. This product becomes soft and plastic when it feels but just warm to the touch. (6) When warm has a peculiar aromatic odor.

Quantitative analyses of the crude lac (stick lac) have been made by different chemists with varying results.

HATCHETT.

Resin	68·0
Wax	6·0
Coloring matter	10·0
Gluten	5·5
Foreign bodies	6·5
Loss	4·0

DR. JOHN.

Resin sol. in ether	66·65
" insol. "	16·75
Coloring matter	3·75
Extractive	3·92
Insect skins	2·08
Wax	1·67
Laccic acid	0·62
Salts	1·04
Sand	0·62
Loss	2·90

FRANKE.

Resin	65·7
Substance of the lac	28·3
Coloring matter	0·6
	94·6

It will be seen from these that *exact* analyses of the lac into its various constituents could not identify it with the India lac when no two analyses agree on the constituents nor on the proportions, the resins being given at from 65·7 to 83·40, and coloring matter at from 0·6 to 10·0 per cent. A partial analysis, however, was made for the purpose of establishing identity as far as could be done by this means.

A portion of the Arizona stick lac was carefully removed from the twigs and boiled with water, and in this way 3·0 per cent. of the deep red coloring matter (colored extract) was obtained. The residue was extracted with boiling alcohol, and about 61·7 per cent. of alcoholic extract, probably mostly resin. Of the residue the greater portion was soluble in dilute caustic potash with deep red color, and reprecipitated by acetic acid for the most part, though a certain coloring substance soluble in caustic potash, but not precipitated by acetic acid, could be detected by again neutralizing the acid filtrate.

A second more thorough examination was made by first extracting the powdered resin, dried before weighing, with hot absolute alcohol, which was found to leave the coloring matter nearly all behind; then extracting the residue with boiling water, and extracting the residue from this with dilute caustic potash. The final insoluble residue was dried and weighed, and caustic potash solution precipitated with acetic acid, filtered, washed on the filter, and the precipitate dried and weighed. By this process there was lost a certain

amount of coloring matter insoluble in water but soluble in caustic potash, but not precipitated by acetic acid, but easily detected in filtrate and wash-water.

The results of these determinations gave—

Resins, etc., soluble in absolute alcohol	61·7
Coloring matter (soluble in water)	1·4
Caustic potash extract ("lac stuff"?)	26·3
Insoluble residue	6·0
Loss (including some coloring matter)	4·6
	100·0

The 26·3 per cent. seems to correspond to what Franke calls "material of the lac" (Muspratt), of which he finds 28·3 per cent. in India stick lac.

It will be seen then how closely the gum lac from Arizona agrees in characteristic properties, structure, and chemical composition with the India varieties. The differences in the analyses quoted are due doubtless partly to different methods of analysis, partly to real differences in different specimens (this is probably peculiarly applicable to the coloring matter), and partly to different interpretations of the results of analysis.

I am informed by Mr. Culbertson that the insect and gum are also found on a thorny bush called "cat-claw" by the residents. It would be very interesting to have the insect identified or compared with the Indian coccus, as their mode of life as well as the products of their activity appears identical.

Since writing the above communication I have received from Arizona specimens of the lac coating the twigs of that plant, which is identified by Professor Hilgard, of this University, as the *Acac a greggii.*

The lac from this source agrees in its main chemical properties with that from the larrea, and behaves the same towards the reagents mentioned in the previous description. It resembles it also in general appearance and in its irregular cellular structure.

It is however much scantier on the twigs of the acacia, and the amount of coloring matter is notably less. This is shown by the color of the caustic potash solution, and of the borax solution being much lighter red than the solutions of the lac from the larrea, and also by the fact that the specimens of acacia lac examined gave no red coloration to water by boiling. It was noticed, however, that when alkalies were added to this water, the color became a bright red. A quite appreciable quantity of alkali was needed before this action took place, pointing to the existence of an acid in the lac which had first to be neutralized before the color could be reddened—possibly Dr. John's *laccic acid* (Muspratt's Chemistry). It is quite possible that this difference in contents in coloring matter is simply due to the fact that the two specimens represented different stages of development. The twigs of the acacia were dry, and the leaves fallen when these specimens were collected. No fresh insect eggs with the purple juice, with which they are covered, could be detected in the cells of these specimens, while in the specimens from the larrea this was frequently observed, and moreover the larrea was in leaf and flower when the specimens were collected. It is quite possible that at other times this difference in the amount of dye-stuff may not exist.

From observations by a number of gentlemen acquainted with that portion of the country, it appears that the larrea lac is very widely distributed throughout Arizona and the southern part of California (Mohave and Colorado deserts), and the gum is used by the inhabitants in place of solder for mending kettles, etc. This use is suggestive of the use of the India lac for the manufacture of sealing-wax. Experience must show whether these products are of such quality as to eventually prove of commercial value.—*Amer. Chem. Journal.*

ANALYTICAL OBSERVATIONS ON TIN.

By G. PELLIZZARI.

AFTER attacking with hydrochloric acid the brown flocks precipitated by zinc from a solution which may contain tin and antimony, there is added potassium sulphocyanide and then ammonium molybdate. If a carmine red coloration appears the presence of tin is indicated. If traces of antimony have been dissolved by the hydrochloric acid the reaction is not interfered with. The tartaric, oxalic, phosphoric, and acetic acids diminish the color produced, or even prevent its formation. Heat also weakens the coloration.

ON THE VOLATILIZATION OF SOLIDS IN VACUO.

By W. DOUGLAS HERMAN.

PROF. MCLEOD, requiring some pure phosphorus, endeavored to obtain some by distilling ordinary phosphorus in an atmosphere of carbon dioxide, but without success. He then wrote to Mr. Herman, who had been investigating the question, inquiring where his paper on the subject was published. In reply, Mr. Herman forwarded the present communication with a request that he would read it. The paper, however, was incomplete. Prof. McLeod therefore gave an abstract of the paper to the London Chemical Society, with a short account of some experiments he had himself made, and exhibited some illustrative specimens. Mr. Herman sealed up some phosphorus in glass tubes containing air, and in vacuous tubes. On distillation in the light the phosphorus in the vacuous tubes condensed in minute yellow crystals. When, however, the distillation was conducted in the dark, most beautiful colorless transparent adamantine crystals were obtained. The phosphorus was dried with filter paper. The author states that when these crystals were exposed to daylight they became rough and opaque, and at the same time yellow or red. As regards the opacity, Prof. McLeod has obtained somewhat different results. Mr. Herman also observed that when phosphorus was heated in sealed tubes to 140° it became surfused, and remained in the liquid state for some months after cooling. This phosphorus turned red in the sunlight. It was interesting to note that the red amorphous phosphorus could therefore be obtained from solid, liquid, and gaseous phosphorus by the action of light alone. In one case a crystal of phosphorus was obtained 8 mm. long. Mr. Herman also made some most interesting experiments with sulphur. Sulphur sealed up in vacuous tubes distilled over at the temperature of boiling water, *i. e.*, 11° below its melting point, and condensed in minute drops of liquid sulphur, forming a cloud on the glass. After a time minute crystals appeared and began to grow, the liquid disappearing *pari passu*, until the whole was converted into crystals. Similar experiments were made with iodine, selenium, ammonium chloride, etc. Prof. McLeod then gave an account of the experiments he had made. He had sealed up phosphorus in glass tubes, carefully absorbing all moisture, by melting the phosphorus in a bulb connected with a second bulb containing phosphorus anhydride. He had obtained most beautiful crystals, some of which were exhibited. They resemble in appearance diamonds, being perfectly colorless, with an adamantine luster, perfectly transparent, and from their high refractive index sparkling with prismatic colors. Prof. McLeod had not been able to confirm Mr. Herman's statement that these crystals became opaque in daylight, and thought that this was due to the presence of a trace of water containing a trace of air; as from experiments he had made, by distilling some phosphorus as above described, and then exposing it to the action of boiled water and light, the crystals became red, but remained transparent. If, however, unboiled water was used a white coating was formed similar to that on ordinary phosphorus kept under water and exposed to light.

The president had listened with great interest to the lucid explanation given by Prof. McLeod; as to the specimens they would speak for themselves. He hoped Mr. Herman would finish and publish his paper, and especially complete the interesting observations about the volatilization of sulphur.

ON A NEW SYNTHESIS OF SALIGENIN.

By WM. H. GREENE.

THE method by which I have obtained saligenin synthetically is an application of a general method for the preparation of phenolic derivatives made known by Reimer and Tiemann. Indeed, since by the reaction of chloroform or of carbon tetrachloride on an alkaline solution of sodium phenate, salicylic aldehyde or salicylic acid may be obtained, it may naturally be expected that, under the same circumstances, methylene chloride would yield saligenin, the latter being an oxybenzylic alcohol.

A mixture of 30 grammes of methylene chloride, 30 grammes of phenol, and 40 grammes of sodium hydrate dissolved in 50 grammes of water, was heated in a sealed matrass in a water bath. The reaction is complete in about six hours, after which the contents of the matrass are neutralized with hydrochloric acid, and agitated with ether, which takes up the saligenin and the excess of phenol. The ethereal solution is decanted, and the ether distilled off; the residue is repeatedly exhausted with boiling water, which takes up the saligenin, and leaves the greater part of the phenol undissolved. The aqueous solution is concentrated to a small volume, and the drops of phenol which separate on cooling are removed. After exposing the residue for some time over sulphuric acid, a crystalline mass is obtained, which is pressed and recrystallized from boiling water or from alcohol. Pure saligenin is thus obtained.

The quantity of saligenin is by no means in proportion to the quantity of phenol employed, and an alcoholic solution of sodium hydrate yields no better results than an aqueous solution, although the reaction takes place more promptly.

Isomeric oxybenzylic alcohols may be, and probably are, found at the same time, but I have not yet been able to isolate such compounds.—*Amer. Chem Journal.*

DISEASED PORK FROM AMERICA.

By P. L. SIMMONDS.

A VERY severe plague, of an extremely infectious character, has been for some years spreading and devastating the vast herds of swine in the United States, which has at last become so wide-spread, and so fatal in its contagious results that the government has instituted an official investigation, the result of which has been recently published in a special report by the Department of Agriculture, which occupies nearly three hundred pages, containing the reports of nine or ten medical men and veterinary surgeons on this serious disease; and it is illustrated by about seventeen microscopical and enlarged colored plates on the various diseased tissues, parasites, etc.

Though long confounded with typhoid fever, anthrax (malignant pustule), erysipelas, measles, scarlatina, etc., the present swine disease appears to be distinct from all of them, and may be defined as a specific contagious fever. It seems highly important that public attention should be drawn to it, in view of our enormous imports of American pork in various forms.

North America is the largest pork raising country in the world, its swine numbering over 28,000,000, as officially recorded; but the actual numbers are believed to be at least 33,000,000, Russia standing second, numbering about 12,000,000 pigs. Pork raising is, therefore, an important element in the agricultural wealth of the great transatlantic republic; and as they send away for foreign consumption such a large supply of pork products, it behooves the consuming countries to watch closely the character of the meat supplied, and to be certain that its consumption is in no way injurious to public health.

Our imports of foreign pork of late years have been very large, and chiefly from America. The following are the official figures of these imports:

	1878.	1879.
Live swine	55,911	52,267
	cwts	cwts.
Bacon	3,466,565	3,996,922
Hams	797,336	906,121
Pork, salted	369,500	400 591
Pork, fresh	18,222	40,049
	4,651,623	5,343,683

Besides this, we have the import of 840,000 to 900,000 cwt. of lard from America. Although we have not yet the specific details of countries shipping for the last year, yet the returns for 1878 show that the bulk of our imports are from the United States, and over 17,000 live pigs came from there in 1878, which may serve to introduce among us this frightfully contagious disease, of which cases are already recorded.

The imports of pork products from the States, in 1878, were:

	cwts.
Bacon	3,169,025
Hams	790,348
Pork, salted	322,148
Pork, fresh	6,451
Lard	901,214

Now, judging from these imports (none of which are reshipped), added to our home production of pork, the flesh of swine enters more largely into the British food supply than would be generally supposed. More than 250,000 pigs are sold annually in the Paris markets, besides those killed annually for household use, and the sale of some 500 tons at the annual ham fair, in Lent. Hungary supplies a great quantity of bacon and lard to the whole of Europe, besides its "salami," or polonies as big as a man's arm, which are largely consumed throughout the Austrian empire.

It is admitted that trichinosis is very prevalent and fatal on the Continent, which can scarcely be wondered at, seeing that bacon and ham are so frequently eaten raw, and that the pork sausages and polonies are not sufficiently cooked to destroy the vitality of the parasite.

The investigations in America show that the parasite worms of swine are numerous. The whip worm (*Tricocephalus Dispai*, or *crenatus*) has been found in large numbers in pigs that had been fed on raw offal. Many years ago, Dr. Fletcher called attention to the destructive effects of the lard worm (*Stephanurus dentatus*) on the liver and other internal organs, and even attributed the hog cholera to its ravages. So with the *Trichina spiralis*, the hook headed worm (*Echinorhynchus gigas*), the common measle hyatid (*Cysticercus cellulosa*), and the liver flukes (*Fasciola hepatica* and *Distomum lanceolatum*). The lung worm prevalent in the present swine plague is the *Strongylus elongatus*, Dry.

The origin of this hog disease in America is attributed to various causes, to overcrowding and filth, to breeding in and in, to the general feeding on Indian corn alone, much of which has been kept and exposed to the elements for some years, to want of liberty, etc. But it is not necessary here to go into causes, or to give medical descriptions in details. The disease is evidently a very ugly one, and the flesh, however prepared, cannot be wholesome or pleasant eating. The quotation of a few of the professional opinions given may, however, be beneficial.

That many of these diseased animals are shipped for human food appears to be admitted. Mr. D. E. Salmon, a veterinary surgeon, reporting to the Commissioners of Agriculture, says (page 130 of the report): "One man remembers that he was employed by the drovers to kill the animals that were sick, and cure the meat; these animals had diseased lungs, and such a bad odor that they could scarcely be dressed."

Mr. Charles M. Keyser, of Cedar Point, Page County, Virginia, thus describes the disease: "Upon examination of those slaughtered, I found their lungs and livers in a very bad condition. The lungs were very much darkened and decayed, and the pores, or small tubes, were filled with worms about the size of a hair; they varied from one to three inches in length, and seemed to completely choke the hog. In color, they resembled that of the kidney worm, though they were not so large. I had no microscope, and could not make a close examination. The liver was full of boils, and seemed to be in a perfectly torpid condition."

Mr. James Law, another of the reporters, is of opinion that, "in the many places where the hogs are turned out as street scavengers, and meet from all different localities, such liberty should be put a stop to wherever the disease appears in the district, and all hogs found at large should be rendered liable to summary seizure and destruction."

Dr. Reuben F. Dyer, thus reports (page 160): "Aggregating a large number of cases in the same herd, you will find all the tissues diseased, but more particularly the lung tissues and the mucous membrane of the intestines."

Dr. Detmers recommends: "1. That any transportation of dead, sick, or infected swine, or even of hogs or pigs that have been the least exposed to the contagion, or may possibly constitute the bearers of the same, must be effectually prohibited. 2. Every one who loses a hog or pig by swine plague must be compelled by law to bury the same immediately, or as soon as it is dead, at least four feet deep, or else to cremate the carcass at once, so that contagious or infectious principles may be thoroughly destroyed, and not be carried by dogs, wolves, rats, crows, etc., to other places."

Dr. D. Y. Voyles reports that the approach of the complaint in any given locality is the signal for the selling of every marketable animal to the summer packers, and yet in the year 1876, there were boiled down for their fat, in the county of Bartholomew, no less than 100,000 animals that died of disease, in that and adjacent counties. In North Carolina, the losses from the disease in the year ending April, 1878, were estimated at 260,000.

Dr. R. F. Dyer reports that, aggregating a large number of cases in the same herds, it will be found that the infectious poison invades all the tissues, to a greater or less extent, but more particularly the lung tissues, and the mucous membrane of the intestines. He forcibly remarks, "when it shall become universally known that diseased animals are being continually slaughtered and packed for shipment, when Europe shall learn that we are sending them cholera hog meat to eat, then one of the greatest sources of revenue to this country will be seriously damaged. It is a notorious fact that the stock yards in Chicago are full of diseased animals. Commission men say that they are selling that class of hogs for slaughtering and packing, and think nothing of it. I know that, in the yards of this town (Ottawa, Ill.), hogs die from this disease, and as healthy hogs are put into the yards preparatory for shipment, they will, of necessity, contract the malady. They are sent to market, and, about the time they should be slaughtered, are taken sick. I know this is not a very pleasant picture for those that like a steak of ham with eggs, but it is a true one; and when Congress can only appropriate the paltry sum of ten thousand dollars to aid in trying to stop this annual loss of twenty or thirty millions of dollars' worth of property, I want every Congressman to just reflect that almost everything he eats has a little lard in it, and that every time he calls for ham he may be eating a piece of 'cholera hog.'"

This is not a pleasant subject to discuss, but it is one of paramount interest, which should be taken up in a legislative point of view, for the interest of the people at large, and to which the public analysts might direct their attention with advantage.—*Journal of the Society of Arts.*

INFLUENCE OF PILOCARPINE ON BALDNESS.

DR. G. SCHMITZ has twice noticed the reproduction of hair on the head of bald patients whom he had treated with hypodermic injections of pilocarpine for eye diseases (*Berlin Klin. Wochensch.*) On an old man, aged sixty, who had been operated on for double cataract, he made three injections in the space of fourteen days; the membrane over the pupil disappeared, as he had expected, but at the same time the head of this man, who was completely bald, became covered with a thick down; and afterward his hair grew and became thicker, so that at the end of four months there was no trace of baldness left, and the patient became the possessor of an abundant crop of hair, partly white and partly black. In the case of another patient, thirty-four years old, suffering from detachment of the retina, the top of the head was entirely without hair on a surface as large as a playing-card. In this case also two injections of the same medicine resulted not only in curing the eye disease, but also in the reproduction of hair.—*Moniteur Scientifique.*

[Continued from SUPPLEMENT No. 230, page 3670.]

FOREST TREES OF NORTH AMERICA.

By CHARLES S. SARGENT, Arnold Professor of Arboriculture in Harvard College, Special Agent Tenth Census.

150. *Fraxinus dipetala*, Hook and Arn. *Ornus dipetala*, Nutt. A small tree. Common in California, west of the Sierra Nevada.

151. *Fraxinus Oregana*, Nutt. *F. pubescens*, var. Hook, Fl. Bor. Am. ii. 51. *F. grandifolia*, Benth. Bot. Sulph. 33. (Oregon Ash.) Puget Sound; south near the coast to Fresno County and the neighborhood of San Francisco, California. Wood said to equal that of the White Ash. A large tree in Oregon and Washington Territory, smaller in California.

152. *Fraxinus pistaciæfolia*, Torr. Southern and Western Texas, to Ash Creek, Southern Arizona. A small tree, "20 feet high, with a diameter of 18 inches."—Rothrock, Wheeler, Rep. vi. 186.

Var. coriacea, Gray, Syn. Fl. i. 74. *F. velutina*, Torr. in Emory Rep., 1848, 1849. *F. coriacea*, Watson, Am. Nat. vii. 302. Rothrock Wheeler, Rep. vi. 186. t. 22. Ash Meadows, Nevada, and Southern Arizona. A small tree.

153. *Fraxinus platycarpa*, Michx. *F. Caroliniana*, Lam. *F. Americana*, Marsh. *F. pallida*, Bosc. *F. pauciflora*, Nutt. *F. triptera*, Nutt. (Water Ash.) Southeastern Virginia to Florida, near the coast, and west to Louisiana and Southern Arkansas; in the West Indies. A small tree, 30 to 40 feet in height; in deep river swamps.

154. *Fraxinus pubescens*, Lam. *F. Pennsylvanica*, Marsh. *F. nigra*, DuRoi. *F. tomentosa*, Michx. f. Canada to Florida; west to Dakota; most common in the Eastern States. A medium-sized tree; borders of swamps, and in low ground.

155. *Fraxinus sambucifolia*, Lam. (Black Ash.) Newfoundland to the southern shores of James Bay; south to the mountains of Virginia; west to Wisconsin and Arkansas. Wood brownish, very tough, elastic; easily separable into thin layers; employed in basket-making, etc. A small or medium-sized tree; in swamps and along low river banks.

156. *Fraxinus quadrangulata*, Michx. (Blue Ash.) Michigan and Wisconsin; south to Northern Alabama. Wood said to equal that of the White Ash. A large tree.

157. *Fraxinus viridis*, Michx. f. *F. concolor*, Muhl. *F. juglandifolia*, Willd. *F. Caroliniana*, Willd.? *F. expansa*, Willd. Canada to Florida; west to Dakota, Texas, and Arizona. A small or medium-sized tree; along streams or in low ground.

Var. Berlandieriana, Gray, Syn. Fl. i. 75. *F. Berlandieriana*, DC. Prodr. viii. 278. Texas.

158. *Chionanthus Virginica*, L. (Fringe Tree.) Lancaster County, and banks of the Brandywine, Chester County, Pennsylvania; Southern Ohio (Newberry) south to Florida and Texas. A shrub or small tree, sometimes 20 to 30 feet in height.

159. *Osmanthus Americanus*, Benth. and Hook. *Olea Americana*, L. (Devil Wood.) Southeastern Virginia to Florida and Alabama, near the coast. Wood exceedingly hard, close-grained, difficult to split or cut. A small tree or shrub.

BORRAGINACEÆ.

160. *Cordia boissieri*, DC. Extreme Southwestern Texas, the adjacent portion of New Mexico, and in Mexico. A small tree, 15 to 20 feet in height.

161. *Cordia sebestena*, L. *C. speciosa*, Willd. Southern Florida, and in the West Indies. A small tree, or often a shrub.

162. *Beurreria Havanensis*, Miers. *Ehretia Havanensis*, Willd. *B. tomentosa*, var. *Havanensis*, Griseb. *Ehretia tomentosa*, Lam. *Pittonia similis*, Catesb. *Ehretia Beurreria*, Chapman [not L.] *B. succulenta*, Jacq. Florida Keys and in the West Indies. A small tree.

Var. radula, Gray, Syn. Fl. i. 181. *B. radula*, Don. *B. virgata*, Griseb. [not Swartz ex Miers.] *Ehretia radula*, Poir. *Cordia Floridana*, Nutt. Sylv. ii. 147, t. 107. Keys of Southern Florida and in the West Indies.

163. *Ehretia elliptica*, DC. Texas, Corpus Christi, and along the valley of the lower Rio Grande. A small tree, 20 to 30 feet in height, with a trunk often a foot in diameter.

BIGNONIACEÆ.

164. *Catalpa bignonioides*, Walt. Gray, Manual, 5 ed., 321, and Syn. Fl. i. 319, in part. *Bignonia catalpa*, L. *C. cordifolia*, Jaume. *C. syringæfolia*, Sims. Western Georgia, Florida, and perhaps west to Louisiana. Wood very light, close-grained, remarkably durable; its specific gravity 0·405, valuable for fence posts and cabinet work. A medium-sized tree.

165. *Catalpa speciosa*, Warder. Engelm. in Coult. Bot. Gazette, v. 1. (Western Catalpa.) Southern Indiana and Illinois, Western Kentucky and Tennessee, Southeastern Missouri, and possibly southward through Louisiana. Wood rather heavier than that of the last species, its specific gravity 0·462; valuable for cabinet work, and almost imperishable when placed in contact with the soil; largely employed for railway ties, fence posts, etc. A large tree in rich bottom lands, often 80 feet in height, with a trunk 4 feet in diameter; one of the most valuable trees of the American forest.

166. *Chilopsis saligna*, Don. *C. linearis*, DC. *Bignonia linearis*, Cav. *C. glutinosa*, Engelm. (Desert Willow.) Southern Texas to Southern California, and south into Mexico. A shrub or small tree, sometimes 20 feet in height; along water courses in the dry districts.

VERBENACEÆ.

167. *Avicennia nitida*, Jacq. *A. tomentosa*, Meyer [not Jacq.] *A. oblongifolia*, Nutt.? (White Mangrove.) Southern Florida; Louisiana, at the mouth of the Mississippi River; and southward to Brazil. A small tree; along the sea coast in saline marshes.

POLYGONACEÆ.

168. *Coccoloba Floridana*, Meisner. *C. parvifolia*, Nutt. [not Poir.] (Pigeon Plum.) Southern Florida; Miami River (Garber), Key West, etc.

169. *Coccoloba uvifera*, Jacq. (Sea Grape.) Southern Florida, Miami River (Garber), Key West; and through the West Indies. Wood violet-colored, very hard, heavy, valuable for cabinet-making. A large tree; the edible fruit of an agreeable sub-acid flavor.

LAURACEÆ.

170. *Persea Carolinensis*, Nees. *Laurus Borbonica*, L. *Laurus Carolinensis*, Catesb. *P. Borbonica*, Spr. (Red Bay.) Southern Delaware to Florida and Eastern Texas; near the coast. Wood rose-colored, very durable, strong, compact, susceptible of a brilliant polish; formerly somewhat employed in ship-building and for cabinet-making. A tree, in the Gulf States, 70 feet in height, with a trunk 15 to 20 inches in diameter.

171. *Sassafras officinale*, Nees. *Laurus sassafras*, L. *Persea sassafras*, Spreng. (Sassafras.) Canada and Northern Vermont, to Florida; west to Missouri, Arkansas, and Eastern Texas. Wood white or reddish, according to soil, light, very durable, slightly aromatic. A tree, sometimes 50 feet in height; the roots, and especially their bark, enter largely into commerce, and afford a powerful aromatic stimulant. The oil of sassafras, distilled from the roots, is largely employed in imparting a pleasant flavor to many articles of domestic use.

172. *Umbellularia Californica*, Nutt. *Oreodaphne Californica*, Nees. *Tetranthera Californica*, Hook and Arn. *Drimypyllum pauciflorum*, Nutt. (Mountain Laurel. California Laurel. Spice Tree. Cajeput. California Olive.) Oregon to San Diego, California, in the coast ranges, and along the western flank of the Sierra Nevada. Wood brownish, close-grained, susceptible of a fine polish, and highly esteemed, especially that of the roots, for cabinet-making, and yielding for this purpose the most valuable material produced by the Pacific forests. In Oregon a tree 60 to 100 feet in height, smaller in California; the leaves yield a volatile oil, *oreodaphne* (Amer. Jour. of Phar., xlvii. 105).

EUPHORBIACEÆ.

173. *Drypetes crocea*, Poit. *Schæfferia lateriflora*, Sw. Southern Florida, Key West, and through the West Indies. A shrub, or on Key West becoming a large tree.—Blodgett.

174. *Sebastiania lucida*, Muell. *Gymnanthes lucida*, Sw. *Excæcaria lucida*, Sw. (Poison Wood.) Southern Florida and through the West Indies. "Wood yellowish white, hard, and close-grained."—Nuttall. A small tree.

175. *Hippomane mancinella*, L. (Manchineel.) Southern Florida, and through the West Indies and Central America to the Pacific. Wood heavy, durable, close-grained, and beautifully variegated with shades of brown, white, and yellow; highly esteemed for cabinet-making. A tree, 30 to 40 feet in height; abounding in white, milky, exceedingly caustic, poisonous sap.

URTICACEÆ.

176. *Ulmus alata*, Michx. *U. pumila*, Nutt. (Whahoo. Winged Elm. Small-leaved Elm.) Southern Virginia to Florida; west to Eastern Nebraska, the Indian Territory, and Southwestern Texas. Wood hard, compact, unwedgeable; employed for hubs of wheels, etc. A small tree, 30 to 40 feet in height.

177. *Ulmus Americana*, Willd. *U. Floridana*, Chapman. (White Elm. American Elm.) Southern Newfoundland, Northern New Brunswick, Lake Nipigon (in latitude 50° N.) south through all the Eastern United States to Florida; west to Nebraska, Kansas, and Eastern Texas. Wood, brown, moderately strong, very tough, unwedgable; employed in the manufacture of hubs, water-pipes, etc. A tree, 60 to 80 feet in height, with a trunk 6 to 9 feet in diameter; generally in deep, moist soil, or low woods.

178. *Ulmus crassifolia*, Nutt. Trans. Am. Phil. Soc. *U. opaca*, Nutt. Southern and Western Arkansas, adjacent portions of the Indian Territory, and south to Southern Texas, from San Antonio to the Pecos River. A small tree.

179. *Ulmus fulva*, Michx. *U. rubra*, Michx. f. (Red Elm. Slippery Elm. Moose Elm.) Canada to Florida, west to Eastern Nebraska, Arkansas, and Louisiana. Wood reddish, hard, heavy, very tough, durable. A small or medium-sized tree; along streams and in low woods; the inner bark mucilaginous, and extensively employed in various medicinal preparations.

180. *Ulmus racemosa*, Thomas. (Rock Elm. American Cork Elm.) Province of Ontario, south to Kentucky, and from Western Vermont (Robbins) to Eastern Nebraska. Wood fine-grained, compact, flexible, very heavy, strong, susceptible of a beautiful polish; its specific gravity 0·832; largely employed in the manufacture of heavy agricultural implements, furniture, and for all purposes requiring a material combining strength, toughness, and solidity. A large tree; of the first economic value.

181. *Planera aquatica*, Gmel. *P. Gmelini*, L. C. Rich. *P. ulmifolia*, Michx. f. *Anonymos aquatica*, Walt. (Planer Tree.) Cape Fear River, North Carolina, and Southern Kentucky, south to Florida and Louisiana. A small tree, 30 to 50 feet in height; along streams. Rare.

182. *Celtis brevipes*, Watson, Proc. Am. Acad. xiv. 297. Rothrock, Wheeler Rep. vi. 238. Near Camp Grant, Southern Arizona (Rothrock). "A small tree, becoming 20 feet high and 18 inches in diameter."

183. *Celtis Mississippiensis*, Bosc. *C. occidentalis*, var. *tenuifolia*, Pers. *C. lævigata*, Willd. *C. occidentalis*, var. *integrifolia*, Nutt. *C. integrifolia*, Nutt. *C. longifolia*, Nutt. Valley of the Mississippi River, from Southern Missouri and Kentucky, south and southwestward to Eastern Texas. A large tree.

184. *Celtis occidentalis*, L. *C. crassifolia* Lam. *C. occidentalis* var. *crassifolia*, Gray. (Sugar Berry. Hackberry. False Elm.) Northern Vermont, south to Western Florida, and west to Nebraska, the Indian Territory, and Texas. Wood white, soft, and probably of little value; somewhat employed as a substitute for American elm. A small, or at the West often a very large tree. [The limits of this and the last species are not yet satisfactorily defined, and the attention of American botanists is called to the importance of studying in the field, and especially in the valley of the Mississippi, this difficult genus, to which further investigation may restore one or possibly two species, or reduce it even still further.]

185. *Celtis Tala*, Gillies, var. *pallida*, Planch. DC. Prodr. xvii. 191. *Celtis* (*Momisia*) *pallida*, Torr. Bot. Mex. Bound. 203, t. 50. In the valley of the lower Rio Grande, and westward through Southern New Mexico to Sonora; and in Southern Florida (Garber, 1879). Generally a shrub, 6 to 10 feet in height, but, as seen by Dr. Garber in Southern Florida, a small tree, sometimes 20 feet in height.

186. *Ficus aurea*, Nutt. Southern Florida, Key West, Indian River (Palmer), Miami (Garber). A large tree.

187. *Ficus brevifolia*, Nutt. Southern Florida, Key West, Miami (Garber). A small tree.

188. *Ficus pedunculata*, Ait. Southern Florida, and common in the West Indies. A large tree.

189. *Morus rubra*, L. *M. Canadensis*, Lam. (Red Mulberry.) Western Vermont, Western Massachusetts, Long Island, New York, and south to Florida; west to Dakota, Kansas, Western Texas, New Mexico, and Chihuahua. Wood yellowish, heavy, exceedingly durable; valuable for posts, treenails, etc.; formerly somewhat employed in ship-building. A small or medium-sized tree, sometimes 70 feet in height, with a trunk 2 feet in diameter, or in the far Southwest reduced to a shrub; the large, dark purple fruit sweet and edible.

190. *Maclura aurantiaca*, Nutt. (Osage Orange. Bois d'Arc.) Southwestern Missouri, south to Natchitoches County, Louisiana, and west into the Indian Territory and Eastern Texas. Wood yellow, solid, heavy, elastic, exceedingly durable; valuable for construction, railway ties, fence posts, etc. A medium-sized tree, sometimes 50 to 60 feet in height, with a trunk 2 to 3 feet in diameter. Very common, and attaining its greatest perfection in the rich bottom lands of the Red and Kiamesha Rivers; now extensively planted as a hedge plant, especially in the Western States.

(*To be continued.*)

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